Learning path for patent examiners

Computer-implemented inventions:
Entry level

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Introduction

This publication, <mark>"Computer-implemented inventions, Entry level"</mark>, is part of the "Learning path for patent examiners" series edited and published by the European Patent Academy. The series is intended for patent examiners at national patent offices who are taking part in training organised by the European Patent Office (EPO). It is also freely available to the public for independent learning.

Topics covered include novelty, inventive step, clarity, unity of invention, sufficiency of disclosure, amendments and search. Also addressed are patenting issues specific to certain technical fields:

- patentability exceptions and exclusions in biotechnology
- assessment of novelty, inventive step, clarity, sufficiency of disclosure and unity of invention for chemical inventions
- the patentability of computer-implemented inventions, business methods, game rules, mathematics and its applications, presentations of information, graphical user interfaces and programs for computers
- claim formulation for computer-implemented inventions

Each publication focuses on one topic at entry, intermediate or advanced level. The explanations and examples are based on the European Patent Convention, the Guidelines for Examination in the EPO and selected decisions of the EPO's boards of appeal. References are made to the Patent Cooperation Treaty and its Regulations whenever appropriate.

The series will be revised annually to ensure it remains up to date.

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All references to natural persons are to be understood as applying to all genders.

Contents

Legal references

1. Learning objectives

Participants to this course will learn:

- The legal basis concerning subject-matter excluded from Patentability
  - Definition (Art. 52 EPC) and its interpretation (BoA)
  - Consequences for the examination of CII applications.

- The EPO practice concerning CII examination, the two hurdle approach:
  - First hurdle, the subject-matter should not be excluded from patentability
  - Second hurdle, all other requirements of patentability have to be fulfilled, in particular inventive step (Art. 56 EPC).

- What are the kind of claims that are accepted at the EPO
  - when the invention can be carried out only with generic data processing means;
  - when the invention is carried out with generic data processing means and some specific hardware.

2. What is a "computer-implemented invention"?

This course is concerned with the patentability of what are known as computer-implemented inventions or CIIs.

But what exactly is meant by this term? What kinds of inventions are we talking about here?

The Guidelines for Examination, F-IV, 3.9 and G-II, 3.6, give the following definition:

"'Computer-implemented invention' is an expression intended to cover claims which involve computers, computer networks or other programmable apparatus wherein at least one feature is realised by means of a computer program."

Since a computer needs to be programmed with a computer program to perform any function, this definition covers
- any computer-implemented method
- any computer, or computer network, with means for carrying out a method
- any computer program comprising instructions which, when the program is executed by a computer, cause the computer to carry out a method
- a computer-readable data carrier having a computer program stored thereon

Examples

A CII does not necessarily have to refer to a computer or a computer program. Less explicit forms of CII are also possible.

Consider, for example, the following claims, which perform digital signal processing by means of a digital process, an image processor or other processing means:
- a mobile phone comprising a digital signal processor for detecting the received signal
- a camera comprising an image processor for improving the contrast of the captured image
- a pulse oximeter having an electromagnetic detector and processing means adapted to process electromagnetic radiation signals to determine oxygen saturation in blood

Since these claims also comprise programmable means, they can be considered as defining a CII.

Legal references:
GL F-IV, 3.9, G-II 3.6

3. Patentable subject-matter

The basis for the patentability of CIIs, and in fact any invention, is Article 52(1) EPC. This provision lays down the principle whereby inventions in all fields of technology are generally entitled to patent protection, provided they are new, involve an inventive step and are susceptible of industrial application.

When this provision is read in conjunction with Article 52(2) EPC, which comprises a list of things which are not to be regarded as inventions, it is clear that for a patent to be granted there must be an invention in a field of technology. If there is no invention, the application can be refused under Article 97(2) EPC.

Although Article 52(1) EPC refers to the terms "invention" and "technology", the legislator deliberately opted not to give a concrete definition for these terms. This was so that adequate protection would be possible for the results of future developments in fields of research which the legislator could not foresee.

However, if the EPC does not spell out what "inventions" and "technology" are, how can it be ascertained whether a patent application contains patentable subject-matter?

The answer lies in the interpretation of Article 52 EPC by the EPO's boards of appeal, an interpretation that has defined an entire framework for examining CIIs. This course will provide an overview of this framework.

Examples

Computer-implemented monopoly game

An application describes a computer-implemented monopoly game and claims:
▪ A computer program which, when executed on a computer, carries out a monopoly game.

Could this be an invention in a field of technology?

Legal references:
Art. 52(1) EPC

4. Exclusions from patentability as per Article 52(2) and (3) EPC

At the EPO, the provisions of Article 52(2) and (3) EPC regulate what kind of subject-matter is excluded from patentability.

According to Article 52(2) EPC, the following **in particular** shall **not** be regarded as **inventions**:
a. discoveries, scientific theories, mathematical methods
b. aesthetic creations

c. schemes, rules and methods for performing mental acts, playing games or doing business, and programs for computers
d. presentations of information

The common denominator here is that all these things and activities can subsist at an abstract level or are no more than abstract creations.

Importantly, as per Article 52(3) EPC, these "abstract" things and activities are **only** excluded from patentability if the patent application relates to them "**as such**".

According to the boards of appeal's interpretation of Article 52 EPC, the effect of the "as such" rider is that claimed subject-matter is not excluded from patentability if it contains something – indeed anything – that counts towards a patentable invention. In particular, the claimed subject-matter must be defined in terms of at least one feature which makes a technical contribution.

Examples

Computer-implemented monopoly game, continued
▪ A computer program comprising instructions which, when executed on a computer, carries out a monopoly game.

Is this a computer program as such, or a scheme, rule or method for playing a game, as such?

Given that programs for computers and schemes, rules and methods for playing games are not regarded as inventions, can it be concluded that this claim is excluded from patentability?

Legal references:
Art. 52(2) EPC; Art. 52 (3) EPC

5. The technical character of a claimed feature

For a time, when the approach to examining CIIs was still in its infancy, an invention was not held to be excluded in cases in which the invention involves some contribution to the state of the art in a field not excluded from patentability. In other words, this test involved a comparison with the state of the art, i.e. everything that is made available to the public prior to the application's filing date. However, this approach was abandoned step-by-step as the boards of appeal recognised that any comparison with the prior art is more appropriate for the purpose of examining novelty and inventive step than for deciding on possible exclusion under Article 52(2) and (3) EPC.

An important step in this direction was taken in decision T 1173/97, *Computer program product/IBM*, dated 1 July 1998, in relation to claims to computer programs. In this decision, the board mentioned, for the first time in the case law of the EPO, that determining the technical contribution an invention achieves with respect to the prior art was more appropriate for the purpose of examining novelty and inventive step. In the context of the decision, the board thus held that a computer program is not excluded from patentability under Article 52(2) and (3) EPC if it brings about a "further technical effect", even if this further technical effect is already known from the state of the art (what exactly is meant by a "further technical effect" produced by a computer will be explained later on). The board was more explicit in the subsequent decision T 931/95, *Controlling pension benefits system*, dated 8 September 2000, holding that there "[was] no basis in the EPC for distinguishing between 'new features' of an invention and features of that invention which are known from the prior art when

examining whether the invention concerned may be considered to be an invention within the meaning of Article 52(1) EPC" and it did or did not relate to excluded subject-matter.

Therefore, the modern approach to assessing whether claimed subject-matter is excluded from patentability is to consider the claimed subject-matter as a whole, without regard to the prior art (GL G-II, 2.).

This view was confirmed by decision T 258/03, *Auction Method/HITACHI*, dated 21 April 2004, which stated that "[w]hat matters having regard to the concept of 'invention' within the meaning of Article 52(1) EPC is the presence of **technical character** which
- may be implied by the physical features of an entity or the nature of an activity, or
- may be conferred to a non-technical activity by the use of technical means".

This test was reworded in T 154/04, *Estimating sales activity/DUNS LICENSING ASSOCIATES,* dated 15 November 2006, according to which having technical character was an implicit requirement of any invention and subject-matter having technical character was not excluded from patentability even if it related to the items listed in Article 52(2) EPC since those items are only excluded "as such". On the other hand, purely abstract concepts devoid of any technical implications are excluded.

In other words, the current test, which is also known as the "first hurdle", is to check whether the claim, taken as a whole, comprises **any** technical, non-excluded, feature. If it does, the claim is said to have "technical character" and defines an invention within the meaning of Article 52(1) EPC.

For example, a "computer-implemented method" requires a computer for carrying out the method. Therefore, it is a method which involves the use of technical means, so it is an invention within the meaning of Article 52(1) EPC and not excluded from patentability.

Other examples are a "computer comprising means for performing a function" or a "computer-readable storage medium storing a computer program". These claims imply physical features of the device they are defining, so they are also considered to involve technical means.

Importantly, this finding depends neither on the function performed by the "computer-implemented method" and the "computer" nor on the type of computer program stored on the "computer-readable storage medium".

On the other hand, a "method for determining the price of a product according to formula X" does not require any technical means. A business method as such, is no more than an abstract concept which is devoid of any technical implications.

Examples

Inventions within the meaning of Article 52(1) EPC

As set out above, any method involving the use of technical means or any device counts as an invention within the meaning of Article 52(1) EPC. Typical examples include:
- a computer-implemented method comprising the steps of …
- a computer comprising means for performing …
- a computer-readable storage medium storing a computer program

In relation to these examples, consider the following:

Does it matter exactly what the method does? For example, is the computer-implementation of an otherwise completely abstract business method excluded from patentability? In the same vein, does it matter what functions the means of the computer performs? What about a computer-readable storage medium which stores a computer program that would be excluded had it been claimed directly?

Example: non-inventions within the meaning of Article 52(2) EPC
- A method for determining the price of a product according to formula X (which is a method for doing business as such; Article 52(2)(c) and (3) EPC).

Typically, things or activities that are purely abstract and devoid of any technical implications are not considered to be an invention within the meaning of Article 52(1) EPC.

Legal references:
Art. 52 EPC, GL G-II, 2, T 1173/97; T 931/95; T 258/03; T 154/04

6. Exclusion or not? The first hurdle

Let us now look at two concrete examples of claimed subject-matter and determine whether it passes the first hurdle, i.e. defines an invention within the meaning of Article 52(1) EPC. If the claimed-subject matter does not pass the first hurdle, it is excluded from patentability and an objection under Article 52(2) and (3) EPC should be raised.

The claim of the first example reads as follows:

"A method for filtering an NxN input matrix **X**, comprising the step of two-dimensionally convolving the NxN matrix **X** with the kernel matrix **H** to calculate the output matrix **Y**, wherein the kernel matrix **H** is given by

$$H = \begin{pmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{pmatrix}.$$"

A first thing to note in relation to this example is that the claimed method does not require a computer-implementation.

Second, a two-dimensional convolution between an input matrix and a kernel matrix is a filtering operation which is typically used to perform image processing. The matrix **H** of this example has been specifically chosen to perform edge detection when it is convolved with an input matrix representing a digital image. However, the claim neither specifies that the filtering operation performs image processing, nor that the input matrix **X** contains an image which has been captured by a camera. Although the claimed method comprises technical embodiments and the determination of the kernel matrix **H** is based on technical considerations, the claim does not require the use of any technical means at all. The method can be performed mentally, at least in principle.

Therefore, the method is considered either a mathematical method as such or a mental act as such, and is therefore not an invention within the meaning of Article 52(1) EPC. It is thus excluded from patentability under Article 52(2) and (3) EPC.

The claim of the second example reads as follows:

"A method for designing a core loading arrangement for loading nuclear reactor fuel bundles into a reactor core to optimise an amount of energy, said method comprising the steps of:
- assigning to each bundle a relative reactivity value according to a reactivity of the bundle relative to the reactivity of the other bundles;
- [steps of an iterative optimisation method]."

This method is also a mental act as such since the designer of the nuclear reactor can carry it out mentally, at least in principle. As in the previous example, the method clearly involves technical considerations. However, if the method can be carried out mentally, even only in principle, technical considerations are not sufficient to escape an exclusion under Article 52(2) and (3) EPC (T 914/02, T 471/05, G 3/08; GL G-II, 3.5.1).

It is, however, easy to modify both of these example claims to overcome an objection under Article 52(2) and (3) EPC. It would be sufficient, for instance, if the claims additionally required a computer-implementation ("a **computer-implemented** method"). Of course, it is also possible to specify other, additional technical means. For example, the image processing method would also pass the first hurdle if it specified technical means for capturing an input image.

The requirement for there to be an invention is a separate, independent requirement to be met by any application. If this requirement is met, the next step in examining the patentability of the claimed subject-matter is to assess whether all other relevant requirements of the EPC are fulfilled. In particular, the claims need to be clear and supported (Article 84 EPC) and the claimed subject-matter needs to
- be disclosed in a manner sufficiently clear and complete for a skilled person to carry it out (Article 83 EPC)
- be novel over the state of the art (Article 54 EPC)
- involve an inventive step (Article 56 EPC)

As apparent from the above two examples, a CII may often involve features which, if viewed in isolation from the computer-implementation, would be considered subject-matter that is excluded from patentability under Article 52(2) and (3) EPC. In these cases, it is customary to speak of "mixed-type" inventions, i.e. inventions that comprise a mix of both technical and non-technical features. Section G-VII, 5.4 of the Guidelines sets out a problem-solution approach which has been specifically adapted for "mixed-type" inventions. Subsection G-VII, 5.4.1 addresses the formulation of the objective technical problem while subsection G-VII, 5.4.2 provides four detailed examples setting out how to apply the problem-solution approach to mixed-type inventions.

Legal references:
Art. 52 EPC, GL G-II, 3.3, GL G-II, 3.5, T 914/02, T 471/05, G 3/08

7. Inventive step: the second hurdle

Inventive step is assessed via the problem-solution approach. An adaptation of the problem-solution approach for mixed-type inventions was first outlined in the board of appeal decision T 641/00 ("COMVIK") and later summarised in T 154/04 ("DUNS"). As confirmed in the recent Enlarged Board of Appeal decision G 1/19, this adaptation of the problem-solution approach is the established case law followed by the EPO when examining CIIs.

According to this adaptation of the problem-solution approach, inventive step is assessed by taking account of all the features which contribute to the technical character of claimed subject-matter. On the other hand, features making no such contribution cannot support the presence of inventive step.

In particular, features which are non-technical when viewed in isolation can still contribute to the technical character. That is, if non-technical features interact with the technical features of a claim and in doing so help produce a technical effect serving a technical purpose, they must be taken into account.

By contrast, non-technical features that do not interact with the technical subject-matter of the claim cannot contribute to the technical character of the claimed invention and are thus ignored when assessing inventive step.

Legal references:
Art. 52 EPC, Art. 54 EPC, Art. 56 EPC, T 641/00, T 154/04, G 1/19

8. Workflow for assessing inventive step

In detail, the problem-solution approach for mixed-type inventions includes the following steps.

In the first step, all the features which contribute to the technical character of the invention are determined on the basis of the technical effects achieved in the context of the invention. This assessment is made independently of any prior art since its purpose is to select a suitable starting point in the prior art.

In the second step, a suitable starting point as the closest prior art is selected by focusing on the features identified in the first step, i.e. all the features which contribute to the technical character of the claimed invention.

In the third step, the differences between the claimed invention and the closest prior art are determined. The technical effect brought about by these distinguishing features in the context of the claim as a whole is then determined. Once the technical effect has been determined, it is possible to identify which distinguishing features make a technical contribution and which do not. At this point, there are three distinct possibilities:
a. There are no differences, not even non-technical ones. In this case, the claimed invention lacks novelty, so an objection is raised under Article 54 EPC.
b. There is a difference but the distinguishing features do not interact with the claim's technical subject-matter to make a technical contribution. In the absence of any technical contribution to the prior art, the claimed invention cannot involve an inventive step. An objection is therefore raised under Article 56 EPC.
c. There is a difference and the distinguishing features make a technical contribution. In this case, the objective technical problem is formulated on the basis of the technical effects achieved by these features. If the distinguishing features also include features making no technical contribution, these features – or any non-technical effect achieved by the invention – may be used in the formulation of the objective technical problem to be solved as part of what is given to the skilled person, in particular as a constraint to be met. Note that this constraint is not the same as prior art, so the skilled person need not know the constraint.

If the claimed technical solution to the objective technical problem is obvious to the skilled person, an objection is raised under Article 56 EPC.

The problem-solution approach for mixed-type inventions is illustrated below by means of two concrete examples.

The first example again concerns the method which performs image processing by filtering an input image with a kernel matrix **H**. To illustrate the assessment of inventive step, the claim has been modified to now specify that the method is computer-implemented and that the input image is captured with a camera and stored in the input matrix **X**.

The claim reads as follows:

Claim 1: "A computer-implemented method for filtering an NxN input matrix **X**, comprising the steps of
- capturing an input image with a camera and storing the image in digital form in the input matrix **X**; and
- two-dimensionally convolving the NxN matrix **X** with the kernel matrix **H** to calculate the output matrix **Y**, wherein the kernel matrix **H** is given by

$$H = \begin{pmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{pmatrix}$$."

The description of the example teaches that the two-dimensional convolution between the input matrix **X** and the kernel matrix **H**, with the coefficients as defined in the claim, performs edge detection.

In the first step of the problem-solution approach, all the features which contribute to the technical character of the invention are determined on the basis of the technical effects achieved in the context of the invention.

The first two steps, namely capturing and storing the image, are clearly technical steps. However, when viewed in isolation the convolving step is a non-technical mathematical step. This non-technical step interacts with the technical capturing and storing steps by performing a computation on the stored image. Moreover, the purpose of processing the input image in this way is to perform edge detection.

The issue is thus whether under these circumstances the convolving step can be considered to contribute to the technical character of the claimed method.

In this context, it is important to keep in mind that there are different categories of non-technical features, each category corresponding to an item on the list of exclusions set out in Article 52(2) EPC. The reason is that the category of the non-technical feature determines whether and under which conditions it can make a contribution to the technical character of the claimed subject-matter.

In this example, the claim's non-technical feature is a mathematical step. According to GL G-II, 3.3, a mathematical method may contribute to the technical character of an invention, i.e. contribute to producing a technical effect that serves a technical purpose, by its application to a field of technology and/or by being adapted to a specific technical implementation.

In this example, the claim contains no details concerning a specific implementation on a computer. The issue is thus whether the convolving step is applied to a field of technology in such a way as to contribute to producing a technical effect.

As mentioned above, the convolving step interacts with the claim's technical features to perform edge detection in an input image. Image enhancement or analysis is generally recognised as a technical purpose within the technical field of image processing, as pointed out in GL G-II, 3.3. Therefore, the mathematical method specified in claim 1 can be considered to make a technical contribution, meaning that all the features of claim 1 need to be taken into account for selecting the closest prior art.

In the third step, the differences between the claimed invention and the closest prior art are determined.

Let us assume that the closest prior art teaches all the features of claim 1 except for the coefficients of the kernel matrix H. Instead, the prior art teaches a different kernel matrix with coefficients that have been set to sharpen an input image when it is convolved with the kernel matrix.

The distinguishing feature, namely the different coefficients, is thus a non-technical feature. Nevertheless, it is possible to determine a technical effect to which the distinguishing feature makes a contribution. In particular, using the new and different kernel matrix of the method of claim 1 produces the technical effect of performing edge detection instead of sharpening the input image.

Therefore, the objective technical problem to be solved may be considered to be how to modify the prior-art image processing method to perform edge detection. In the absence of any further prior art which teaches or suggests the kernel matrix of claim 1, an inventive step can be acknowledged.

The second example concerns a method for predicting outcomes of marketing campaigns. The corresponding claim reads as follows:

Claim 1: "A computer-implemented method predicting outcomes of marketing campaigns with a plurality of elements, comprising the steps of:
- determining a response probability and a response value for each customer who is a target of the campaign;
- predicting the outcome using the response probability and the response value;
- assigning and reassigning the customers to the campaign elements by an optimisation algorithm wherein each assignment is recorded in a binary map, such that the algorithm provides a best goal value for the marketing campaign."

In the first step of the problem-solution approach, all the features which contribute to the technical character of the invention are determined on the basis of the technical effects achieved in the context of the invention. In this case, the method steps are all non-technical – they are either steps of a business method or steps of a mathematical method.

Moreover, they clearly do not contribute to the technical character of the claimed method since they do not serve a technical purpose.

Therefore, the only feature which needs to be taken into account for selecting the closest prior art is the fact that the method is computer-implemented.

Remember that in practice examiners should still try to find as many features of the claimed invention as possible. Searching for prior art that has as many features as possible in common with the claimed invention, even if these features are non-technical, will generally facilitate more efficient examination proceedings.

For the purpose of this exercise, though, let us assume that the business method is novel and cannot be found in the prior art. Therefore, the closest prior art is a general-purpose computer.

Consequently, the distinguishing features identified in the third step of the problem-solution approach contain all the claim's method steps (which are all non-technical). In this example, none of the method steps interacts with the computer-implementation to serve a technical purpose. The purpose is entirely commercial. The distinguishing method steps therefore do not make any technical contribution over and above the general-purpose computer.

Without any technical contribution to the prior art, the claimed invention cannot involve an inventive step. Consequently, an objection needs to be raised under Article 56 EPC.

Legal references:
Art. 52 EPC, Art. 54 EPC, Art. 56 EPC, GL, Index for CII, GL G-II, 3.3, GL G-VII, 5.4

9.   Exclusion of computer programs: first hurdle

According to Article 52(2)(c) and (3) EPC, computer programs as such are not regarded as an invention within the meaning of Article 52(1) EPC. In other words, they are excluded from patentability. But what exactly is a computer program as such?

Computer programs have the unique property that they can be used to implement subject-matter or activities excluded from patentability, for example a computer program comprising instructions which, when the program is executed on a computer, can cause the computer to
- perform a mathematical method which computes the number π,
- generate an aesthetic creation, such as a piece of music, or
- aid the performance of a mental act, such as designing a bicycle.

Therefore, if all computer programs were allowed, the exclusions could be circumvented.

On the other hand, if all computer programs were absolutely excluded from patentability, the patenting of some inventions which are undoubtedly technical would be denied.

Therefore, the technical-character criterion has been interpreted by the EPO's boards of appeal in a particular manner.

Excluding computer programs as such poses a special problem since any program inherently produces some technical effects when run on a computer. Therefore, among the items or activities listed in Article 52(2) EPC, computer programs are the odd one out. Yet if these technical effects were sufficient to acknowledge technical character, all computer programs would be patentable, even those that merely implement subject-matter or activities excluded from patentability.

Decision T 1173/97, *Computer program product/IBM*, dated 1 July 1998, therefore held that the technical effects that a computer program inevitably causes by virtue of changing the state of a

computer when run are technical effects which are **not sufficient** to escape an exclusion under Article 52(2) and (3) EPC.

However, a computer program may also produce **further technical effects** that go beyond the effects that are inherent to executing a computer program as such. The board concluded that "(a) computer program product is not excluded from patentability under Article 52(2) and (3) EPC if, when it is run on a computer, it produces a further technical effect which goes beyond the 'normal' physical interactions between program (software) and computer (hardware)".

Since the exclusions under Article 52(2) and (3) EPC are assessed by considering the claimed subject-matter as a whole, without regard to the prior art, the further technical effect on the basis of which the computer program is considered to have technical character can be known.

Furthermore, if a method has a technical character over and above the mere fact that it is computer-implemented, a corresponding computer program specifying that method is considered to produce a further technical effect when run on a computer (GL G-II, 3.6.1).

Some examples of methods which bring about a technical effect include:
- controlling an anti-lock braking system
- determining emissions by an X-ray device
- compressing video signals

A corresponding computer program, i.e. one which specifies a method that produces a regular technical effect, is therefore considered to produce a further technical effect and is thus not excluded from patentability. Moreover, if a method of this type is considered new and inventive, the corresponding computer program is normally also allowable with respect to the requirements of Articles 52(1), 54 and 56 EPC.

In addition to computer programs which specify a technical method, there are two further possibilities of how a computer program can bring about a "further technical effect".

One is through a computer program that has been designed on the basis of specific technical considerations regarding the internal functioning of the computer on which the computer program is to be executed, e.g. by being adapted to the specific architecture of the computer. For instance, computer programs implementing security measures for protecting boot integrity or countermeasures against power analysis attacks have a technical character since they rely on a technical understanding of the internal functioning of the computer. Similarly, a computer program for reducing polynomials (i.e. a computer program which, when executed, carries out a mathematical method) can bring about a further technical effect by exploiting word-size shifts matched to the word size of the computer hardware on which the polynomial reduction is performed.

Another possibility is controlling the internal functioning or operation of a computer. Possible examples include the balancing of processor load or of memory allocation. Despite controlling the functioning of a computer, builders (or compilers) are only considered to bring about a technical effect when code generation is hardware-dependent. For example, when building runtime objects from development objects, regenerating only those runtime objects that result from modified development objects helps produce the further technical effect of limiting the resources needed for a particular build.

The EPC does not require any specific claim wordings for defining a computer program. Like any other claim, however, a claim to a computer program must be clear and supported within the meaning of Article 84 EPC. Section F-IV, 3.9 of the Guidelines provides a list of examples of claim formats which are considered to fulfil the requirements of Article 84 EPC. These claim formats will be considered later in the course.

The concept of "further technical effects" will now be illustrated by two concrete examples.

The first example considers the following claim:

Claim 1: "A computer program comprising instructions which, when executed by a general-purpose computer, performs a method comprising the steps of
- reading a digital input image that has been obtained from a camera and storing that image in an NxN input matrix **X**; and
- two-dimensionally convolving the NxN matrix **X** with a kernel matrix **H** to calculate the output matrix **Y**, wherein the kernel matrix **H** is given by

$$H = \begin{pmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{pmatrix}$$."

As set out earlier, a mathematical method may contribute to the technical character of an invention, i.e. contribute to producing a technical effect that serves a technical purpose, by its application to a field of technology and/or by being adapted to a specific technical implementation.

As already mentioned, the convolving step interacts with the claim's technical features for the technical purpose of performing edge detection in an input image. Image enhancement or analysis is generally recognised as a technical purpose within the technical field of image processing (GL G-II, 3.3). The convolving step therefore contributes to producing the technical effect of performing edge detection.

Hence, the technical effect produced when the computer program is executed is a further technical effect which goes beyond the "normal" physical interactions between any program and a general-purpose computer.

The computer program of claim 1 is therefore not excluded under Article 52(2)(c) and (3) EPC.

Would this conclusion still hold if the reading step was modified to "reading data and storing that data in an NxN input matrix **X**"?

The second example considers the following claim:

Claim 1: "A computer program comprising instructions which, when executed by a computer, carry out a method predicting outcomes of marketing campaigns with a plurality of elements, the method comprising the steps of:
- determining a response probability and a response value for each customer who is a target of the campaign;
- predicting the outcome using the response probability and the response value;
- assigning and reassigning the customers to the campaign elements by an optimisation algorithm wherein each assignment is recorded in a binary map, such that the algorithm provides a best goal value for the marketing campaign."

The method steps carried out when this method is executed are all non-technical steps, in particular a combination of a business method and a mathematical method. Moreover, since predicting the outcomes of marketing campaigns is exclusively a commercial or business purpose, the non-technical steps of the method do not serve a technical purpose. The computer program has not been designed on the basis of specific technical considerations regarding the internal functioning of the computer either, nor does it control the internal functioning or operation of a computer in any specific way.

Hence, the technical effects produced when executing the computer program do **not** go beyond the "normal" physical interactions between any program and a general-purpose computer. In other words, the computer program does not bring about a further technical effect.

The computer program in claim 1 is therefore **excluded** under Article 52(2)(c) and (3) EPC.

Legal references:
Art. 52(2) EPC ; Art. 52(3) EPC, GL G-II, 3.6.1, T 1173/97

10. Allowability of multiple independent claims for CIIs

Under Rule 43(2) EPC, the number of independent claims is limited to one in each category. Generally, and subject to the exceptions specified in sub-paragraphs (a), (b) and (c), this would mean one independent claim in the product (or device, apparatus, etc.) category and one in the method category. Moreover, Rule 62a EPC provides that if an application contains a plurality of independent claims in violation of Rule 43(2) EPC, the examining division can invite the applicant to indicate the claims complying with Rule 43(2) EPC, on the basis of which the search is to be carried out.

In addition to this general rule, section F-IV, 3.9.1 of the Guidelines prescribes an extended set of categories for computer-implemented inventions. Accordingly, no objection is raised under Rule 43(2) EPC, and no invitation is sent under Rule 62a(1) EPC, for a claim set containing only one claim from each of the following categories:
- method
- apparatus/system/product
- computer program
- computer-readable medium

If there is more than one independent claim in each of these four categories, the exceptions under Rule 43(2) EPC apply.

Legal references:
R. 43(2) EPC, R. 62a(1) EPC, GL F-IV, 3.9.1

11. Formats for claims directed to CIIs

As you may remember from the beginning of this course, a CII involves computers, computer networks or other programmable apparatus in which at least one feature is implemented by means of a computer program. A computer program in turn is a description or specification of a method which is suitable for execution on a computer.

Two different situations can be identified in this context:

a. All the method steps can be carried out by generic data processing means, i.e. a general-purpose computer; see GL F-IV, 3.9.1.

b. At least one method step defines the use of specific data processing means (e.g. a parallel computer architecture) or other technical devices (e.g. a sensor); see GL F-IV, 3.9.2.

Usually, a claim set for a CII starts with an independent method claim, but further independent claims may be needed for optimal protection, for instance:

- an apparatus claim
- a computer program [product] claim
- a computer-readable [storage] medium claim

Section F-IV, 3.9.1 of the Guidelines gives an example, non-exhaustive list of acceptable claim formulations to cover CIIs where all method steps can be carried out by generic data processing means:

- Method claim (claim 1)
    - A computer-implemented method comprising steps A, B, etc.
    - A method carried out by a computer comprising steps A, B, etc.

- Apparatus/device/system claim (claim 2)
    - A data processing apparatus/device/system comprising means for carrying out [the steps of] the method of claim 1.
    - A data processing apparatus/device/system comprising means for carrying out step A, means for carrying out step B, etc.
    - A data processing apparatus/device/system comprising a processor adapted to/configured to perform [the steps of] the method of claim 1.

- Computer program [product] claim (claim 3)
    - A computer program [product] comprising instructions which, when the program is executed by a computer, cause the computer to carry out [the steps of] the method of claim 1.
    - A computer program [product] comprising instructions which, when the program is executed by a computer, cause the computer to carry out steps A, B, etc.

- Computer-readable [storage] medium/data carrier claim (claim 4)
    - A computer-readable [storage] medium comprising instructions which, when executed by a computer, cause the computer to carry out [the steps of] the method of claim 1.
    - A computer-readable [storage] medium comprising instructions which, when executed by a computer, cause the computer to carry out steps A, B, etc.
    - A computer-readable data carrier having stored thereon the computer program [product] of claim 3.
    - A data carrier signal carrying the computer program [product] of claim 3.

In the second situation described above, where a method claim includes steps defined as being carried out by devices other than generic data processing means, to fulfil the requirements of Article 84 EPC a corresponding device and/or computer program claim may need more than a mere reference to the method claim as in formulations (i)-(iv) in F-IV, 3.9.1 (see also F-IV, 3.8).

In particular in applied fields such as medical devices, measuring, optics, electro-mechanics or industrial production processes, method claims frequently involve steps of manipulating or interacting with technical physical entities using computer control.

The computer cannot always perform all these method steps, so the method claim then requires specific technical means for carrying out some of the steps. In that case, defining a computer program claim as set out above will normally lead to an objection under Article 84 if the step carried out by the specific technical means cannot be carried out by a generic data processing means.

To avoid an objection under Article 84 EPC, the computer program claim may thus have to refer to the specific technical means as features which are essential to a proper definition.

The following example illustrates these principles. It concerns a method of determining oxygen saturation in blood by means of a pulse oximeter by receiving electromagnetic radiation signals with an electromagnetic detector. The corresponding method claim reads as follows:

1. A method of determining oxygen saturation in blood in a pulse oximeter, comprising:
   – receiving in an **electromagnetic detector** first and second electromagnetic radiation signals from a blood-perfused tissue portion corresponding to two different wavelengths of light;
   – normalising said electromagnetic signals according to steps A, B and C to provide normalised electromagnetic signals;
   – determining oxygen saturation based on said normalised electromagnetic signals according to steps D and E.

Now consider the following claims of the other three claim categories:

2. A pulse oximeter having means adapted to execute the steps of the method of claim 1.
3. A computer program comprising instructions which, when the program is carried out by a computer, causes the computer to execute the method of claim 1.
4. A computer-readable medium having stored thereon the computer program of claim 3.

While claims 2 and 3 recite means capable of executing a computer program, they lack the means to carry out the method of claim 1. Therefore, an objection under Article 84 EPC arises.

This objection can be overcome by referring to the same pulse oximeter as the method of claim 1, as follows:

1. …
2. A pulse oximeter having means adapted to execute the steps of the method of claim 1.
3. A computer program comprising instructions which, when the program is carried out by a computer **of a pulse oximeter**, causes the **pulse oximeter** to execute the method of claim 1.
4. A computer-readable medium having stored thereon the computer program of claim 3.

Consider also this alternative formulation of claim 1, in which the step of receiving first and second electromagnetic radiation signals in an electromagnetic detector has been replaced with a step of receiving **data representing** the first and second electromagnetic radiation signals. In other words, the input of the method is data that has been previously obtained by an electromagnetic detector and stored in the memory of a computer:

1. A method of determining oxygen saturation in blood in a pulse oximeter, comprising:
   – receiving **data representing** first and second electromagnetic radiation signals from a blood-perfused tissue portion corresponding to two different wavelengths of light;
   – normalising said **data** according to steps A, B and C to provide normalised electromagnetic signals;
   – determining oxygen saturation based on said normalised **data** according to steps D and E.

Now consider the following claims of the other three claim categories:

2. A pulse oximeter having means adapted to execute the steps of the method of claim 1.
3. A computer program comprising instructions which, when the program is carried out by a computer of **a pulse oximeter**, causes the a **pulse oximeter** to execute the method of claim 1.
4. A computer-readable medium having stored thereon the computer program of claim 3.

Are these claims now clear within the meaning of Article 84 EPC?

The answer is yes because the reformulated method of claim 1 can now be carried out by generic data processing means. As a consequence, no reference to the electromagnetic detector is needed in claims 2 and 3.

In summary, when specific data processing means and/or other additional devices referred to in a method claim are omitted in the corresponding computer program and device claims, this normally leads to an objection under Article 84 EPC (lack of clarity and lack of support for missing essential features). Additionally, an objection under Article 84 EPC can also arise if the claims do not specify which steps are carried out by the generic data processing means and which are carried out by the additional devices/specific data processing means, as well as the interactions between them.

Note that the computer program or device claim need not include features which are implied by the generic terms used. For example, a claim to a "bicycle" implies the presence of wheels. Therefore, failure to mention the wheels does not automatically lead to an objection under Article 84 EPC. Similarly, a claim which refers to a computer does not necessarily need to specify a processor, a memory, a display, etc. However, when specific data processing means are required for executing the computer program, they need to be recited.

Examples

Further example of an unclear computer program claim
- Claim 1: A car comprising means to automatically maintain a given velocity.
- Claim 2: A computer program which causes the car of claim 1 to automatically maintain a given velocity.

Why is the computer program not clearly defined here?

Legal references:
Art. 84 EPC, GL F-IV, 3.9.1, GL F-IV, 3.9.2