Europäisches Patentamt
European Patent Office
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Learning path for patent examiners

Claim formulation for computer-implemented inventions (CII):
Advanced level

Version: May 2024

Introduction

This publication, "Claim formulation for computer-implemented inventions (CII), Advanced level", 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:

- How a set of allowable claims has to be formulated in order to give the best protection possible to the applicant.
- How to formulate acceptable computer program claims when the invention cannot be carried out with generic data processing means.
- How to recognise and examine distributed inventions.

2. Claims related to CIIs

This course is concerned with claim formulations for "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

However, 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. Computer-implemented method vs. computer program

As we have seen, one form of a CII is a computer-implemented method, and another related form is a computer program.

A computer-implemented method is defined in terms of a list of method steps that make up the method. By contrast, a computer program is defined in terms of instructions which can be executed by a computer. Instead of defining the computer program in terms of a concrete program listing, the instructions are claimed in an abstract way by specifying that the instructions perform a method when they are executed by a computer. Often, the computer program simply refers back to the method defined in other claims.

It is important to note that there is a logical and real distinction between a method carried out by a computer and the sequential list of instructions which specify that method. As pointed out in G 3/08, a computer program is a claim to a **description of a method**, i.e. a description which can be parsed by a computer, and not a claim to the method itself.

Moreover, the category of a computer program is distinguished from that of the corresponding computer-implemented method. This is often underlined by using the term "computer program product" instead of just "computer program". Nevertheless, both a "computer program product" and a "computer program" denote exactly the same thing, so both terms define exactly the same subject-matter and can be used interchangeably.

Legal references:
G 3/08; T 424/03

4. Formats for claims directed to CIIs

As we have seen, a CII involves computers, computer networks or other programmable apparatus in which at least one feature is realised 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.

Three 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.
c. The computer-implemented invention is implemented in a distributed computing environment; see GL F-IV, 3.9.3.

We will now consider each of these three situations in more detail.

Legal references:
GL F-IV, 3.9; GL F-IV, 3.9.1; GL F-IV, 3.9.2; GL F-IV, 3.9.3

5. CIIs requiring only generic data processing means

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

Why are these further independent claims necessary to provide "optimal" protection?

To answer this question, we need to digress briefly to the topic of patent infringement.

National patent legislation across the European Union was reformed in the late 70s and early 80s so that it had, as far as possible, the same effect in the relevant European countries as the corresponding provisions of the European Patent Convention and the Community Patent Convention (the predecessor to the "European patent with unitary effect" which never came into force). This triggered harmonisation of the manner in which national patent legislation regulated patent infringement. As such, when it comes to patent infringement, national laws distinguish only between product and process claims and no other claim categories exist – there is no distinct category of computer programs in this context.

Moreover, proving patent infringement differs for products and processes. A product claim is directly infringed if a product falling under the product claim is made, offered, put on the market or used, or if the product is imported or stocked for these purposes.

On the other hand, for a process claim to be directly infringed, a process falling under the process claim has to be used. Alternatively, the claim would be infringed if the infringer offers the process for use within the territory of a national state in which the infringer knows, or it is obvious in the circumstances, that it is prohibited to use the process without the patent proprietor's consent.

In other words, whereas offering a product does not require any knowledge, offering a process requires that the infringer knows that the process is protected in the country where the offer is made. This is also known as the double territorial requirement. A patent proprietor claiming infringement bears the burden to prove that the infringer had this knowledge.

Therefore, a product claim is generally considered to offer stronger protection than a process claim. Since the computer program falls under the product category, a claim directed to a computer program arguably offers better protection than one to a corresponding computer-implemented method. This illustrates why it is important that applicants claim corresponding products and computer programs in addition to the computer-implemented method.

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

Let us briefly go through the formulations proposed by the Guidelines:

- 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.

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

6. CIIs requiring special-purpose hardware

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 EPC 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 explicitly 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 electromagnetic detector as the method of claim 1, as follows:

1. (claim 1…)
2. A pulse oximeter having an electromagnetic detector and means adapted to execute the steps of the method of claim 1.
3. A computer program comprising instructions to cause the device of claim 2 to execute the steps of 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:

1. A data processing apparatus having means for carrying out the method of claim 1.
2. A computer program comprising instructions which, when the program is executed by a computer, cause the computer to execute the method of claim 1.
3. 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.

We will now have a look at some further examples.

The first example concerns a helicopter rotor, and in particular the torque which spins the helicopter around the vertical or "yaw" axis.

According to the description:

"A helicopter rotor (6, 7) creates a torque which spins the helicopter around the vertical – 'yaw' - axis, whereby the magnitude of this torque depends on the 'collective pitch angle' of the main rotor blades. To prevent this happening, a tail rotor (10) creates a counter-torque. Furthermore, in the state of the art, a single, fixed tail fin is profiled and mounted at an angle such that when the helicopter is in forward flight, the airflow around the fin creates a force in the horizontal plane, which creates an additional counter-torque. The amount of power consumed by the tail rotor can therefore be reduced. However, this only works optimally for a certain helicopter load, power setting and forward speed range, and performance losses are incurred when operating outside this envelope. To overcome this, a controllable rudder (14) is provided to vary the force provided by the tail fin."

The corresponding claims filed with the application read as follows:

1. A method of controlling yaw in a helicopter having a main rotor, an anti-torque tail rotor, a vertical tail fin with a rudder for producing a lateral force, an actuator for pivoting the rudder, and a processor, comprising:
   (a) measuring forward speed and collective pitch angle;
   (b) receiving, by the processor, forward speed and collective pitch angle signals;
   (c) calculating, by the processor, a control signal for the actuator as a function of said signals;
   (d) providing, by the processor, the control signal as an output to the actuator;
   (e) controlling the actuator in response to the control signal to pivot the rudder.
2. A computer program product comprising instructions which, when executed by a processor, causes the processor to carry out the method of claim 1.

According to claim 2, the computer program carries out the method of claim 1 when it is executed by a processor. The method, however, comprises steps which cannot be carried out by a processor. In particular, step (a) of measuring forward speed and collective pitch angle requires sensors in the helicopter. Similarly, since step (d) already provides a control signal output to the actuator, step (e) of actually controlling the actuator is not carried out by the processor either.

Therefore, an objection needs to be raised under Article 84 EPC. The computer program product is not clearly defined since the processor cannot carry out the method of claim 1.

A second example concerns integrated circuits, and in particular the issue of depositing layers on a substrate to create an integrated circuit of this kind.

According to the description:

"Integrated circuits have evolved into complex devices that can include millions of components (e.g. transistors, capacitors and resistors) on a single chip. The evolution of chip designs continually requires faster circuitry and greater circuit density. The demands for greater circuit density necessitate a reduction in the dimensions of the integrated circuit components.

The demands for greater integrated circuit densities also impose demands on the process sequences used for integrated circuit manufacture. As the manufacturing process is based on the formation of a stack of layers, the irradiation of the upper layers may influence the properties of the underlying layers. To prevent this from happening, an anti-reflective coating (ARC) that is also a good insulator is needed.

An organosilicate layer is compatible with integrated-circuit production processes and can be used as an ARC. The inventive process sequence includes forming the organosilicate layer on a substrate by applying an electric field to the gas mixture comprising a phenyl-based silane compound in the deposition chamber."

The corresponding claims filed with the application read as follows:

1. A method of depositing a layer on a substrate in a **deposition chamber**, comprising:
   - providing a gas mixture to the deposition chamber, wherein the gas mixture comprises a compound X; and
   - applying an electric field to the gas mixture in the deposition chamber to **form** a **layer X'** on the substrate.

2. A computer storage medium containing a software routine that, when executed, causes a general-purpose computer to control a **deposition chamber** using a **layer deposition** method of claim 1.

A similar issue to the last example arises here too. According to the claims, software stored on the computer storage medium causes a general-purpose computer to control a deposition chamber using a layer deposition method of claim 1.

The method claim, however, contains two method steps of providing a gas mixture and applying an electric field to the gas mixture. The method does not specify the technical means that are used to perform these steps in a deposition chamber. The claim does not refer to any sensors, actuator, controller or any other control parameters. It is therefore unclear what kind of data the general-purpose computer needs to provide to control said deposition chamber. In other words, the technical means or features of the method of claim 1 on which the computer would act are unclear.

The computer storage medium in claim 2 is therefore not clear within the meaning of Article 84 EPC.

The third example concerns a method for discriminating a micro-organism.

1. A method for discriminating a micro-organism, the method comprising the steps of:

a. a step of subjecting a sample containing a micro-organism to mass spectrometry to obtain a mass spectrum;
b. a reading step of reading a mass-to-charge ratio m/z of a peak derived from a marker protein from the mass spectrum; and

c. a discrimination step of discriminating which bacterial species of *Escherichia coli*, Shigella bacteria, and *Escherichia albertii* the micro-organism in the sample contains based on the mass-to-charge ratio m/z, etc.

Here too, there is a step which cannot be performed by a general-purpose computer, namely step (a) of subjecting a sample containing a micro-organism to mass spectrometry to obtain a mass spectrum. To carry out this step, a mass spectrometer is needed. In line with GL F-IV, 3.9.2, therefore, a corresponding device and/or computer program claim would need to make reference to a mass spectrometer in order to fulfil the requirements of Article 84 EPC.

The corresponding claims could be formulated as follows:

2. A device for discriminating a micro-organism, the device comprising:
   – a mass spectrometer adapted to obtain a mass spectrum of a sample containing a micro-organism;
   – programmable means for executing the steps of the method of claim 1.

3. A computer program comprising instructions to cause the device of claim 2 to execute the steps of the method of claim 1.

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

7. CIIs implemented in a distributed computing environment

Another common type of CII is implemented in a distributed computing environment.

One example is a networked client, such a smartphone, which communicates with a server system, in the sense that the smartphone and the server system are interrelated products which jointly perform a function. The smartphone could, for example, access processing resources of a computer cloud to perform a function which is computationally too complex for the smartphone to handle.

Other examples include
- a plurality of devices which co-operate in a peer-to-peer network to share files
- an augmented reality environment with head-mounted displays, where the augmentation data is downloaded from a computer cloud
- maintaining a blockchain by a distributed consensus mechanism

Since these types of distributed inventions involve a plurality of interrelated devices or products, as specified in the exception mentioned in Rule 43(2)(a) EPC, it is permitted to have one independent claim for each of the devices involved in the distributed invention. Although Rule 43(2)(a) EPC only mentions interrelated products, it is also permitted to define a method from the perspective of each of the involved devices. For example, if the distributed invention involves a mobile phone for transmitting a signal and a base station for receiving and processing the signal, there can be one independent claim for the mobile phone, one for the base station, one for a method of transmitting a signal by a mobile phone and one for a method of receiving and processing a signal by a base station.

Nevertheless, each independent claim must independently fulfil all the patentability requirements under the EPC, in particular novelty, inventive step and clarity and support of the claims.

For example, if the invention is based on how a transmitter encodes data very efficiently, i.e. with low computational complexity, the corresponding decoder may already be known in the art. Similarly, if the invention is based on the implementation of a computer cloud which allocates resources to virtual machines in a novel and inventive manner, a client device accessing and using the resources may be known in the art.

In both of these examples, the inventive features are not truly distributed across several devices. Instead, all the features which give rise to the technical effect that solves a technical problem reside in only one of the devices despite there being two independent claims directed at two interrelated devices. In cases such as these, it is only possible to claim one of a number of interrelated products.

If the inventive features are indeed distributed across several devices, it is usually necessary to refer to the specific features of the different devices and to define how they interact with each other to ensure the presence of all the essential features. Similarly, in the case of interrelated methods, it is usually necessary to define which method step is carried out by which device. In some cases it may only be possible to properly define the invention by a system claim comprising a plurality of interrelated devices.

These principles will now be illustrated in more detail by means of examples.

The first example has already been briefly mentioned. Here there are two claims – one for a transmitter device and another for the receiver device

1. A transmitter device comprising means for encoding data by performing steps A and B and means to transmit the encoded data to a receiver device.
2. A receiver device comprising means for receiving encoded data from a transmitter device and means for decoding the data by performing steps C and D.

So, the transmitter device encodes data using an algorithm involving steps A and B and the receiver device performs a complementary decoding function involving steps C and D. As mentioned before, having two independent device claims is permitted since interrelated products are one of the exceptions mentioned in Rule 43(2) EPC.

Concerning method steps A and B performed by the transmitter device and method steps C and D performed by the receiver device, there are two possibilities.

First, the encoding method might be better than known encoding methods. For example, the encoding method performs source encoding which compresses speech signals to a higher degree than any known source encoder. The decoder then has to perform corresponding decoding steps to expand the speech signals to an intelligible format.

Second, the technical effect might be produced only by the encoder or the decoder. For example, if the encoder produces the same encoded signal as a known encoder but is capable of doing so with less computational complexity, then any known decoder will be able to decode the signal. Here, the invention resides solely in the transmitter device, not in the receiver device. In that case, the applicant could only maintain the transmitter claim – and possibly a system claim comprising both the transmitter and the receiver devices.

Another example concerns a server for processing queries from a user device, the server device being configured to perform the steps of

- receiving, from antivirus software deployed on the user device, system-state and configuration data indicative of use of the user device; and
- receiving different queries based on the system-state and configuration data collected by and automatically transmitted from the antivirus software of the user device, said queries being directed to different cloud-based security services provided by the server, etc.

Although these two receiving steps are performed by the server, they refer to steps performed by the user device.

The first receiving step, for example, refers to antivirus software deployed on the user device which produces system-state and configuration data indicative of use of the user device. However, the fact that the system-state and configuration data are generated by antivirus software on the user device cannot limit the first receiving step, and thus cannot limit the server. Similarly, the second receiving step specifies that the system-state and configuration data trigger the automatic transmission by the antivirus software of queries directed to different cloud-based security services provided by the server. However, all that occurs at the server (which carries out the method) is the receipt of a number of queries directed to the cloud-based security services provided by the server. Again, not all the features of the second receiving step can actually limit the server itself.

It is therefore possible to raise an objection under Article 84 EPC by arguing that it is unclear how the steps performed by the user device actually limit the claimed server.

In addition, the features which are not capable of limiting the claimed server can be ignored when assessing the novelty and inventive step of the server.

Legal references:
Art. 54 EPC; Art. 56 EPC; Art. 84 EPC, GL F-IV, 3.9.3

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