# Large Language Model as an Interface and Interpreter

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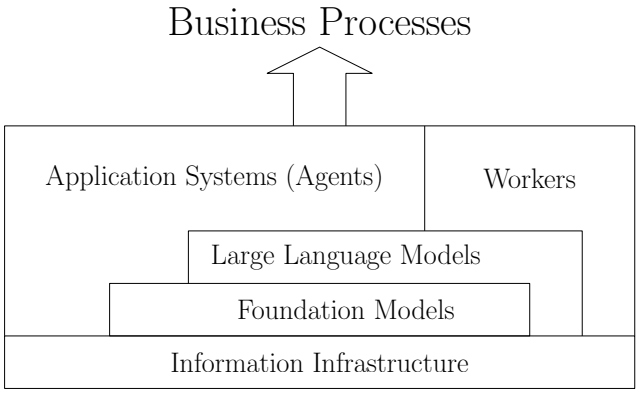



Figure 1: The stack of LLM and agents. LLM plays the vital role in business process automation and re-engineering.

# 1 Roles of an LLM

Due to the advancement of large language models, like ChatGPT and Gemini, and their associated foundation models, various application systems could be easily developed in the form of agents to facilitate business process automation. Figure 1 shows the stack of these modules.

## 1.1 Information Infrastructure

The layer *information infrastructure* includes the Internet, the telecommunication networks, the database systems, cloud platforms, computers and others. This layer provides services to support the upper layers in terms of data/information storage, data/information processing and numerical computation.

## 1.2 Foundation Models

The layer *foundation models* covers a number of generative AI models, including LLMs, LRMs, text-to-image generators, text-to-video generators, text-to-audio generators, translators. These foundation models provide services mainly to support the *LLM layer* and the agents.

### 1.3 Large Language Models

Each LLM in the layer *large language models* acts as an interface[1] in between the application systems (resp. workers) and the foundation models (resp. information infrastructure). Workers benefit the most from the LLM as each LLM is able to understand human language. To instruct an LLM to complete a simple task, a worker can simply type the instructions in natural language and then the LLM will do it accordingly. A worker does not have to learn any new programming language.

### 1.4 Application Systems (Agents)

The *application systems* are responsible for completion of those jobs which are pre-assigned. In simple words, each application system is an agent. It acts on behalf of a worker to complete a job which is used to be completed manually.

## 2 Support Business Processes

The ultimate purpose of these layers is to support the business processes of a firm, see Figure 2. In it, the *information/physical infrastructure* is an extension of the *information infrastructure* as shown in Figure 1.

### 2.1 Information/Physical Infrastructure

The *information/physical infrastructure* covers not just the infrastructure for the information, but also the infrastructure for the physical facilities and human resources. Thus, the *information/physical infrastructure* manages (i) all the resources (including but not limited to information resource, financial resource and human resource) within a firm and (ii) the resources available for public (over or not over the Internet).

### 2.2 Interactions Among Layers

In Figure 2, a business process is accomplished by a number of human workers together with the underlying application systems. A human worker in

[1] An LLM acts as a programming language interpreter. For a program its commands are coded by an interpreted language, the interpreter converts each command to a machine code sub-routine and then executes the sub-routine right the way. Afterward, the interpreter converts and executes the next command. The process repeats until no more command left.

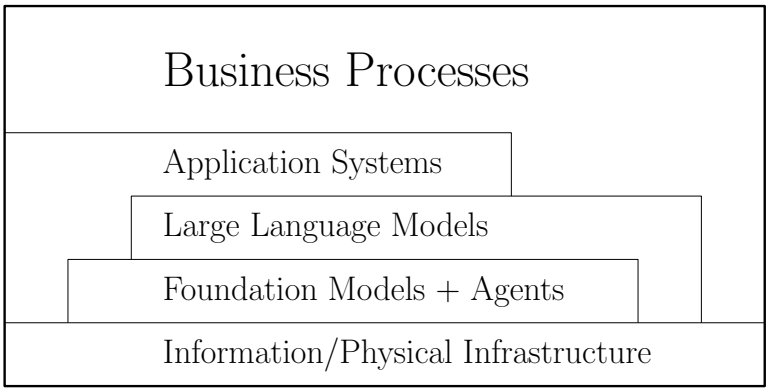



Figure 2: The ultimate purpose of the layers of technologies is to support the business processes of a firm. The physical infrastructure embraces the physical facilities (for logistic), machines and human resources.

a business process might need to directly interact with (i) an LLM, (ii) the foundation models, (iii) the agents or (iv) the *information/physical infrastructure* to complete a task.

A human worker could simply interact with an LLM to complete the task. But, human worker might also interact with the resources in the *information/physical infrastructure* to complete the task. For an application system, it could interact with an LLM to complete its task. Besides, it could interact with the *foundation models + agents* layer and/or the *information/physical infrastructure* layer to complete a task. Clearly, a smart human worker could skip the LLMs layer and directly interact with the *foundation models + agents* layer and/or the *information/physical infrastructure* layer to complete a task. However, this part is not shown in Figure 2 due to the 2D diagram constraint.

### 2.3 Human in a Business Process/Application System

Here, we consider that human worker is a part of a business process and/or an application system. In convention, an application system is normally developed entirely by accessing the foundation models and the pre-developed systems in the *information infrastructure* layer without needed to access any LLM. With the LLMs, a worker in a business process and/or an application system can develop his/her personalized application systems which entirely rely on top of the LLMs but not the underlying *foundation models* layer or *information/physical infrastructure* layer.

### 2.4 Business Process Automation/Reengineering

Recent successes can be witnessed from the incorporating of the LLMs in *knowledge management processes* and *adminstration processes* in a firm, in which the processes require a lot of (i) information collection and processing; and (ii) document generation. The LLMs automates these tasks without changing the design of the existing the *knowledge management processes* and *adminstration processes*.

To succeed a radical improvement, business processes might have to be co-designed with the supporting application systems. That is to say, business process re-engineering[2] might be needed.

### 2.5 Example: Replenishment Process

A possible design for the replenishment process is shown in Figure 3. In this design, a number of assumptions have to be made.

- The replenishment process is initiated by the logistic center information system (LCIS). A program in the LCIS has been scheduled to be running at 22:00 each day.
- A worker in the EC logistic center will log in the LCIS every working day for the list of items with low stock level.
- A worker in the factory will log in the factory information system every working day for the list of replenished items and the list of qualified items being delivered to the EC firm.

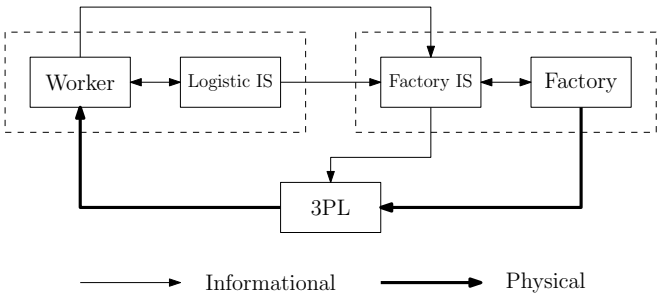
Figure 4 lists the detail steps to be accomplished in the process design as shown in Figure 3.

## 3 Go Beyond

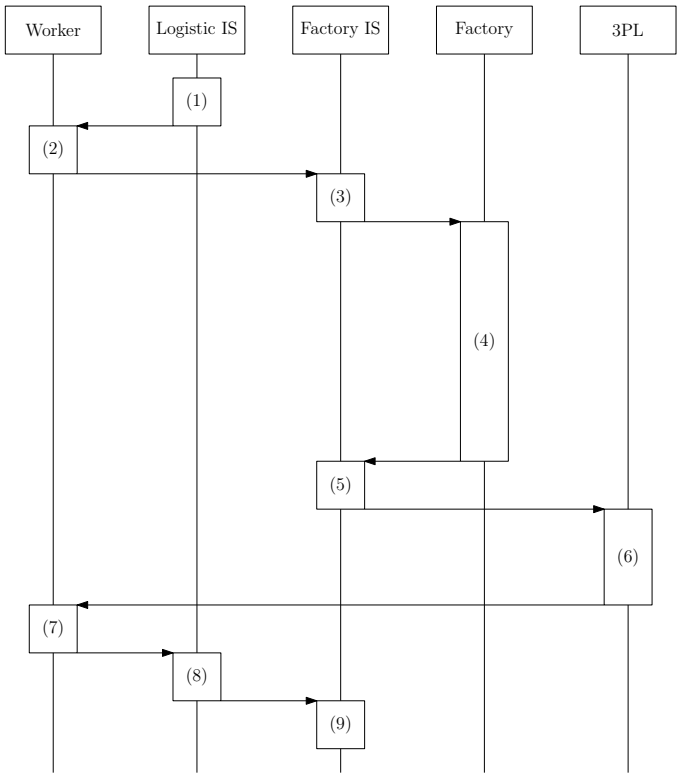
To go beyond, the success of an LLM as a user interface[3] could lead to a *drastic convenience* in global resource access. A user does not have to learn from a bunch of *instruction manuals* on the commands or the procedures in accessing those resources. As long as those resources are accessible, the LLM will act on behalf of the user to access them, see Figure 5.

[2]Hammer, Micheal (1990). Reengineering work: Don't automate, obliterate, *Harvard business review*, 68(4), 104-112. Wikipedia: `https://en.wikipedia.org/wiki/Business_process_re-engineering`.

[3]Clearly, we can consider an LLM as a personal assistant, as described in Section 1.




(a) Interaction diagram.




(b) Sequence diagram.

Figure 3: The *interaction* and *sequence* diagrams of a replenishment process. It involves both information flow and physical material flow. AI tools and information infrastructure could speed up the information flow, while the flow of physical material in the production and delivery cannot.

```
------------------------------------------------------------
Replenishment Process
------------------------------------------------------------
Step 1: 1.1: LCIS checks from the DBMS the stock level
             of each item for sale.
        1.2: LCIS compiles a list of items which stock
             levels are below their pre-set levels.
Step 2: 2.1: A worker check the list of items with low
             stock levels.
        2.2: A worker decides a list of items to be
             replenished.
        2.3: The list of items is sent to the FIS.
Step 3: 3.1: The FIS updates the request in the DBMS.
        3.2: The FIS informs the factory for production.
Step 4: 4.1: Factory produces the requested replenishment.
        4.2: A worker in the factory updates the
             production status to the FIS.
Step 5: The FIS informs a 3PL for delivery.
Step 6: 6.1: The 3PL arrives the factory and collects
             the items.
        6.2: The 3PL delivers the items to the logistic
             center of the EC firm.
Step 7: 7.1: A worker in the EC logistic center checks
             the items for defective.
        7.2: A worker puts the item to its shelf.
Step 8: 8.1: If an item is not defective, its bar code
             will be scanned and its information is thus
             entered in the LCIS.
        8.2: The LCIS informs the FIS for those qualified
             items.
Step 9: The FIS updates its DBMS for those qualified items.
------------------------------------------------------------
```

Figure 4: List of the steps for the process design as shown in Figure 3.

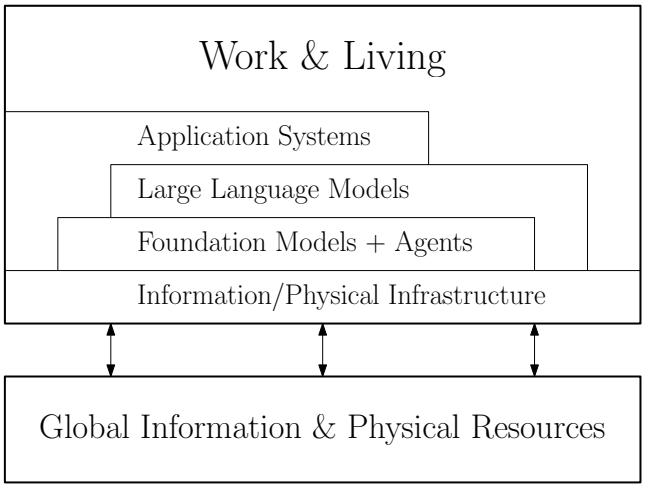



Figure 5: The LLMs and the underlying technologies could support a user to (i) access any global information/physical resource and (ii) complete a task on his/her behalf.

### 3.1 LLM-as-a-Service (Agent)

Once a user has a task to be accomplished, the user can simply give *verbal instructions* to an LLM. Then, the LLM will (i) interpret the instructions, (ii) orchestrate the appropriate foundation models, agents and other available software systems, (iii) access those available resources on the globe, (iv) complete the task and (v) report the results to the user.

In other words, the future LLMs and the underlying technologies could support a user to (i) access any global information/physical resource and (ii) complete a task on his/her behalf. If we follow the terminology from cloud technology, I will say that LLM-as-a-service. It is in analog to *software-as-a-service* or *platform-as-a-service*. Besides, we could also say that an LLM is an agent, a personal assistant or a companion.

### 3.2 LLM-Agent as a Digital Twin

Once a user allows an LLM agent to act on his/her behalf, the user can also set the agent's behavior and thinking exactly the same as himself/herself. In the end, the LLM agent could be perceived as the user's digital twin who is living in the virtual world.

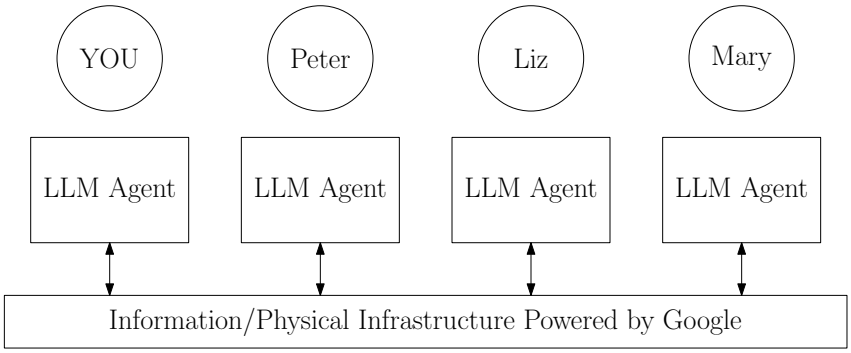



Figure 6: LLM agents are logically connected to form a network of personal agents

### 3.3 Interfacing Global Virtual Computer

Once we consider the Internet together with the resources being connected as a virtual computer, the LLMs are now the user interfaces for this global-wise virtual computing machine. The number of users of this global computer will definitely raise drastically in the coming years.

While the number of users to the global computer raises, the number of LLM users will definitely raise. Owing to their user-friendly nature, users will likely be relying a lot more on these LLMs. Almost every person in the world will be binding to at least one LLM for his/her work and living. To this end, privacy preservation will be a critical issue to every user. *How to protect our privacy during our use the LLMs for work and living becomes an important problem every user has to solve.*

### 3.4 Personal Agents

To go further beyond, an LLM can act as an agent on your behalf. Depending on your authorization, your LLM agent can read your the mails in your Gmail. It can create, read, write and delete a file in your Google Cloud. It can access an online shopping platform and place an order on a food or a goods on your behalf. Even so, it can pay by your credit card for the order. It can interact with your friends' LLM agents to plan for a party. For your work, your LLM agent can interact with your colleagues' LLM agents in collaborative works and for meetings. Your manager's LLM agent might interact with your LLM agent on your promotion issue. Virtually, all these LLM agents form a logical network on top of an *information/physical*

Table 1: List of potential global virtual computers.

| GVC | LLM | Users/Clients | Scale |
|---|---|---|---|
| Alibaba | Qwen | EC Coporate | Giant |
| Amazon | Claude[a] | EC Coporate | Giant |
| Apple | ? | Personal | ? |
| Google | Gemini | Personal & Coporate | Giant |
| Huawei | Pangu | Personal & Coporate | ? |
| Meta | Llama | Social networkers & Metaversers | ? |
| Microsoft | ChatGPT[b] | Coporate | Giant |
| Tencent | Hunyuan | Social networkers | ? |
| XAI | Grok | Social networkers | ? |

[a]Developed by Antrophic. [b]Developed by OpenAI.

*infrastructure*. Likely, the infrastructure is powered by Google, Figure 6.

## 3.5 Global Virtual Computers (GVCs)

Clearly, not all technology firm can realize a *global information/physical infrastructure* to support a *global virtual computer* with dedicated *foundation models*, *LLM* and *cloud*. To be a *global virtual computer*, Google and Microsoft can definitely do so. XAI might be. A list of a potential LLM-powered global virtual computers are depicted in Table 1.

### 3.5.1 Gemini, Co-Pilot and Grok

Currently, two technology firms can do so. They are *Google* and *Microsoft*. It is anticipated that *Google* targets mainly on *personal users* and minor on *working group users*, while *Microsoft* targets mainly on *working group users*. The XAI Grok is yet another LLM which can support similar functions as Microsoft Co-Pilot and Google Gemini. As XAI is attached with the social network X, we could infer that the target users of Grok is the group of the *social network X users*.

### 3.5.2 Claude and Llama

Anthropic and Meta, which have also been developing large language models and the associated foundation models, are targeting on other user segments. Anthropic is a firm getting investment from Amazon. So, it is believed that

the LLM Claude is developed inline with the need for online shopping of Amazon. Meta's LLM Llama is developed for other specialized group of users which has yet to be identified. One possible group of users is the *Metaverse* members.

### 3.5.3 Qwen, Pangu and Hunyuan

A number of global virtual computers from China have recently been launched and advanced. They include the Alibaba Cloud, the cloud from Huawei and the cloud from Tencent. Alibaba targets on EC enterprises. Huawei targets on personals and home users. Tencent targets on social networkers. These three LLM-powered GVCs are clearly targeting mainly on the users from China. Moreover, the customer segment of Alibaba is now not just limited to China EC enterprises, but also the EC enterprises from the South East Asia and even from the Europe. The scales of Alibaba, Huawei and Tencent could be gigantic if they merge.

## 3.6 Concrete Operational Machine

Follow the cognitive stages raised by Jean Piaget, the cognitive stage of this LLM agent could be up to the *concrete operational stage*. The LLM agent is able to understand the instructions given by the user and then complete the task accordingly. So, I would say that the current LLM agent together with the global virtual computer behaves as a *concrete operational machine*. *Formal operational machine* has yet to be realized.

# 4 Privacy & Security : Trust Issue

It is clear that *privacy and security* must be a concern to every LLM user. To this end, a user can only rely on his/her believe and trust on the technology firm which provides the LLM, the foundation models and agents. One can only believe (resp. trust) that the technology firms like Google and Microsoft will not steal our personal information and furthermore will defense ourseleves against malicious attacks.