



INTRODUÇÃO À COMPUTAÇÃO COGNITIVA

Cleber Hostalácio de Melo

GTE – Gerência de Tecnologia



THE CENTAUR
EXCAVATIONS AT VOLOS



Do you believe in centaurs?



Vólos, Grécia



Vólos

Βόλος

Grécia



Ensolarado · 31 °C
17:25



Rotas



SALVAR



PROXIMIDADES



ENVIAR PARA
SMARTPHONE



COMPARTILHAR

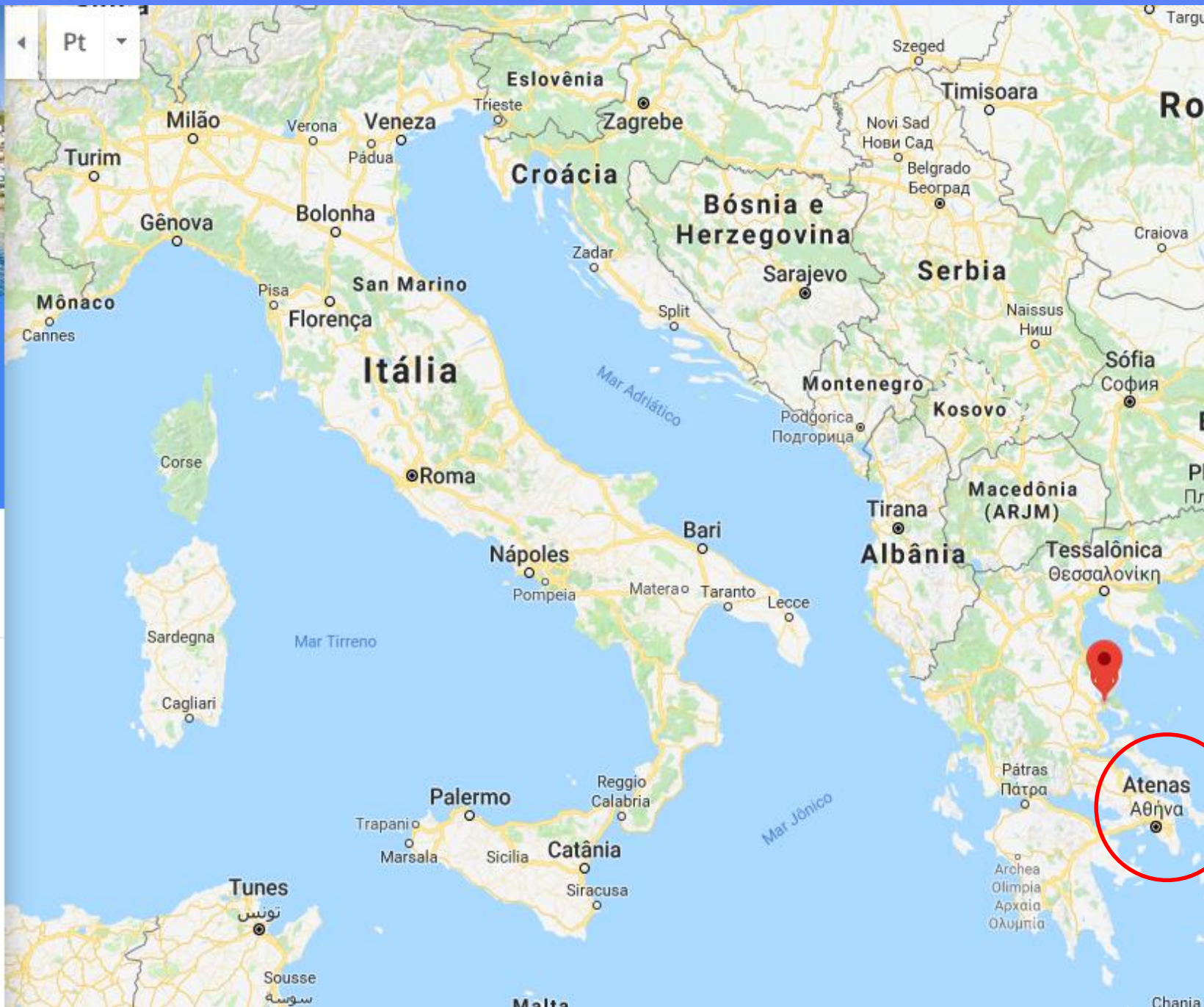


Fotos



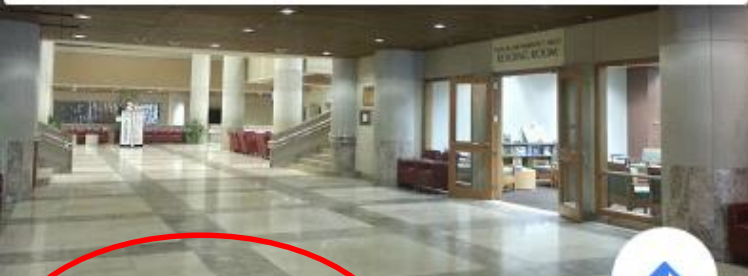
Fatos rápidos

Vólos é uma cidade situada no centro da Grécia, a cerca de 326km ao norte de Atenas e 215km ao sul de Tessalônica. É a capital da prefeitura da Magnésia. [Wikipédia](#)



John C. Hodges Library, Knoxville

Pt



John C. Hodges Library

Knoxville, TN 37916

EUA

Rotas

SALVAR

PROXIMIDADES

ENVIAR PARA SMARTPHONE

COMPARTILHAR

Adicionar um lugar ausente

3 fotos



The map displays a section of Knoxville, Tennessee, centered around the intersection of Cumberland Ave (US-70) and White Ave. Key locations marked include:

- John C. Hodges Library**: Located on the east side of White Ave, near the intersection with Volunteer Blvd. It is circled in red.
- University of Tennessee**: Located to the southeast of the library, also circled in red.
- Centro médico Fort Sanders Regional Medical Center**: Located to the northwest of the library.
- Restaurante mexicano**: Several Mexican restaurants are marked, including Chipotle Mexican Grill, Moe's Southwest Grill, and Zaxby's Chicken Fingers & Buffalo Wings.
- Restaurante chinês**: Panda Express is marked.
- Churrascaria**: The Original Copper Cellar (Upstairs) is marked.
- McDonald's**: Located near the intersection of Cumberland Ave and Lake Ave.
- Drogaria Walgreens**: Located near the intersection of Cumberland Ave and White Ave.
- Garagem de estacionamento**: Lake Ave Parking Garage is marked.
- Hess Hall**: Located near the intersection of Melrose Ave and Lake Ave.
- Clarence Brown Theatre**: Located near the intersection of Melrose Ave and Caledonia Ave.
- Chick-fil-A**: Multiple locations are marked throughout the area.

Streets shown include Cumberland Ave, White Ave, Lake Ave, Melrose Ave, Caledonia Ave, Terrace Ave, Mountcastle St SW, S 21st St, S 17th St, S 16th St, S 15th St, S 14th St, S 13th St, S 12th St, S 11th St, S 10th St, S 9th St, S 8th St, S 7th St, S 6th St, S 5th St, S 4th St, S 3rd St, S 2nd St, S 1st St, S 0th St, S -1st St, S -2nd St, S -3rd St, S -4th St, S -5th St, S -6th St, S -7th St, S -8th St, S -9th St, S -10th St, S -11th St, S -12th St, S -13th St, S -14th St, S -15th St, S -16th St, S -17th St, S -18th St, S -19th St, S -20th St, S -21st St, S -22nd St, S -23rd St, S -24th St, S -25th St, S -26th St, S -27th St, S -28th St, S -29th St, S -30th St, S -31st St, S -32nd St, S -33rd St, S -34th St, S -35th St, S -36th St, S -37th St, S -38th St, S -39th St, S -40th St, S -41st St, S -42nd St, S -43rd St, S -44th St, S -45th St, S -46th St, S -47th St, S -48th St, S -49th St, S -50th St, S -51st St, S -52nd St, S -53rd St, S -54th St, S -55th St, S -56th St, S -57th St, S -58th St, S -59th St, S -60th St, S -61st St, S -62nd St, S -63rd St, S -64th St, S -65th St, S -66th St, S -67th St, S -68th St, S -69th St, S -70th St, S -71st St, S -72nd St, S -73rd St, S -74th St, S -75th St, S -76th St, S -77th St, S -78th St, S -79th St, S -80th St, S -81st St, S -82nd St, S -83rd St, S -84th St, S -85th St, S -86th St, S -87th St, S -88th St, S -89th St, S -90th St, S -91st St, S -92nd St, S -93rd St, S -94th St, S -95th St, S -96th St, S -97th St, S -98th St, S -99th St, S -100th St.

Computação Cognitiva

Procura-se uma definição convincente!

Cognitive Computing Consortium



Pivotal



CustomerMatrix



ektron



Cognitive Computing Consortium

Cognitive Computing Defined

Cognitive computing makes a new class of problems computable. It addresses complex situations that are characterized by ambiguity and uncertainty; in other words it handles human kinds of problems. In these dynamic, information-rich, and shifting situations, data tends to change frequently, and it is often conflicting. The goals of users evolve as they learn more and redefine their objectives. To respond to the fluid nature of users' understanding of their problems, the cognitive computing system offers a synthesis not just of information sources but of influences, contexts, and insights. To do this, systems often need to weigh conflicting evidence and suggest an answer that is "best" rather than "right".

Cognitive computing systems make context computable. They identify and extract context features such as hour, location, task, history or profile to present an information set that is appropriate for an individual or for a dependent application engaged in a specific process at a specific time and place. They provide machine-aided serendipity by wading through massive collections of diverse information to find patterns and then apply those patterns to respond to the needs of the moment.

Cognitive computing systems redefine the nature of the relationship between people and their increasingly pervasive digital environment. They may play the role of assistant or coach for the user, and they may act virtually autonomously in many problem-solving situations. The boundaries of the processes and domains these systems will affect are still elastic and emergent. Their output may be prescriptive, suggestive, instructive, or simply entertaining.

In order to achieve this new level of computing, cognitive systems must be:

Adaptive

They must learn as information changes, and as goals and requirements evolve. They must resolve ambiguity and tolerate unpredictability. They must be engineered to feed on dynamic data in real time, or near real time.

Interactive

They must interact easily with users so that those users can define their needs comfortably. They may also interact with other processors, devices, and Cloud services, as well as with people.

Iterative and stateful

They must aid in defining a problem by asking questions or finding additional source input if a problem statement is ambiguous or incomplete. They must "remember" previous interactions in a process and return information that is suitable for the specific application at that point in time

Contextual

They must understand, identify, and extract contextual elements such as meaning, syntax, time, location, appropriate domain, regulations, user's profile, process, task and goal. They may draw on multiple sources of information, including both structured and unstructured digital information, as well as sensory inputs (visual, gestural, auditory, or sensor-provided).

Cognitive systems differ from current computing applications in that they move beyond tabulating and calculating based on preconfigured rules and programs. Although they are capable of basic computing, they can also infer and even reason based on broad objectives.

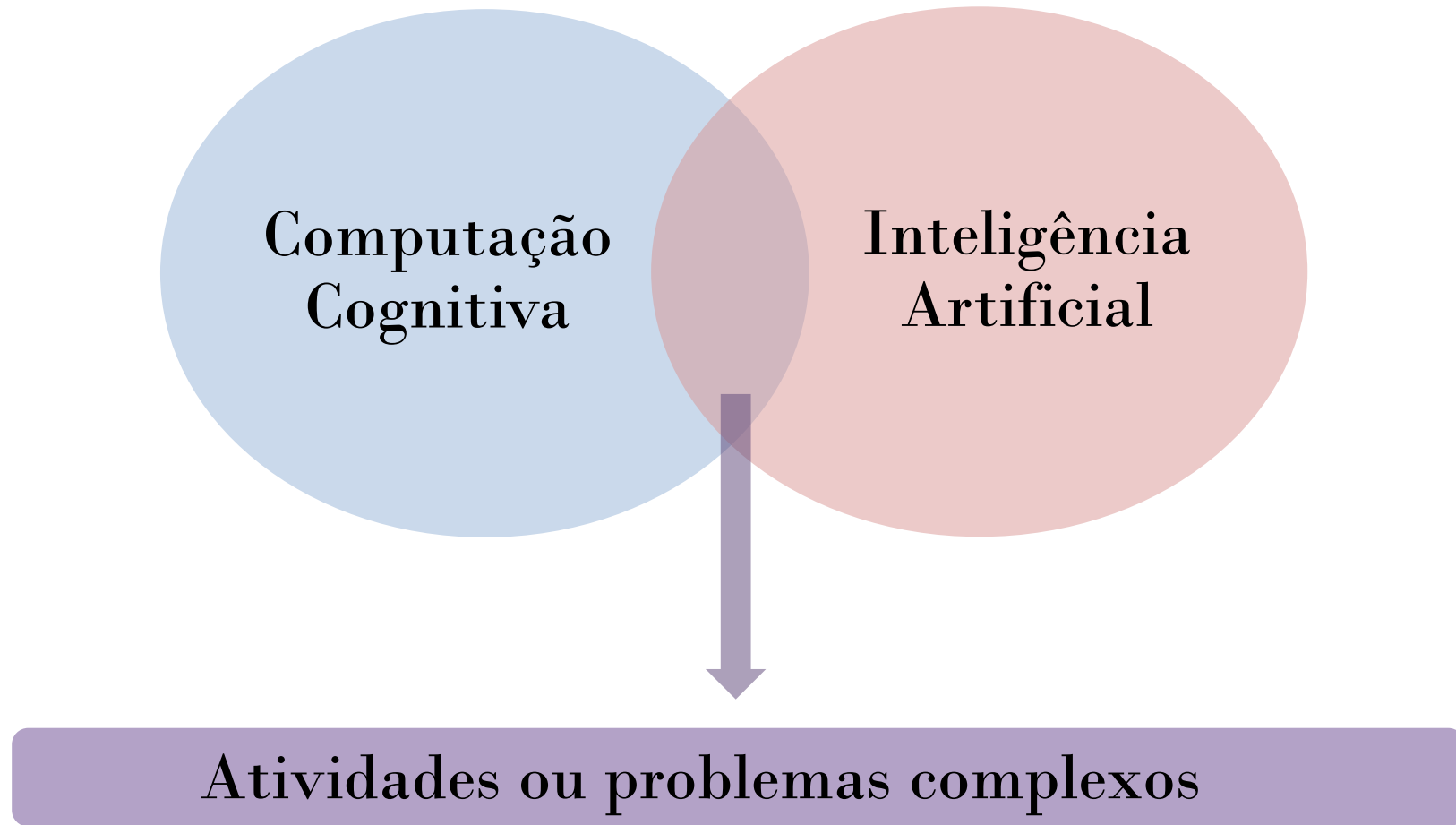
Beyond these principles, cognitive computing systems can be extended to include additional tools and technologies. They may integrate or leverage existing information systems and add domain or task-specific interfaces and tools as required.

Many of today's applications (e.g., search, ecommerce, eDiscovery) exhibit some of these features, but it is rare to find all of them fully integrated and interactive.

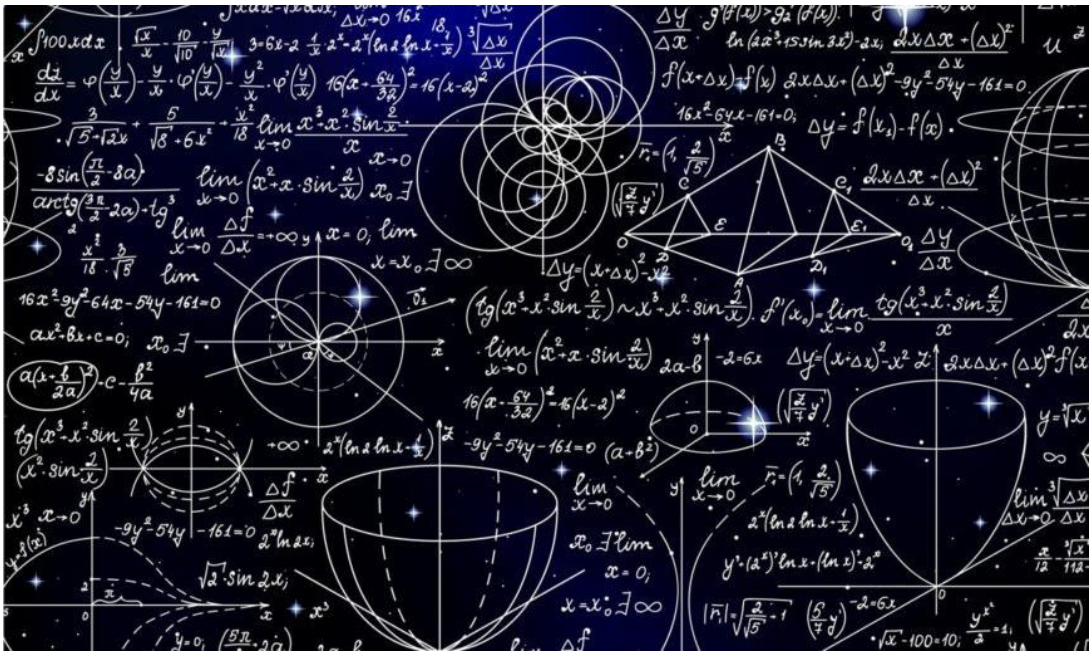
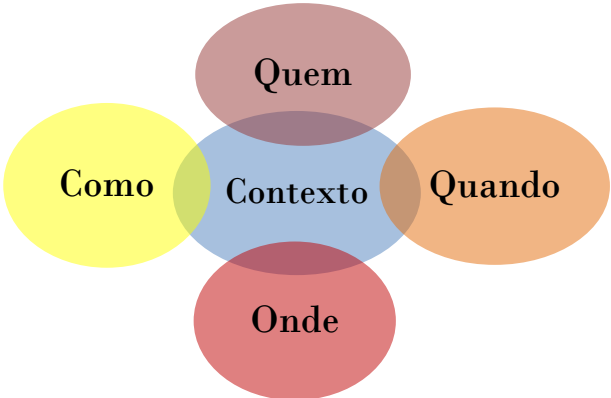
Cognitive systems will coexist with legacy systems into the indefinite future. Many cognitive systems will build upon today's IT resources. But the ambition and reach of cognitive computing is fundamentally different. Leaving the model of computer-as-appliance behind, it seeks to bring computing into a closer, fundamental partnership in human endeavors.

Cognitive Computing Consortium

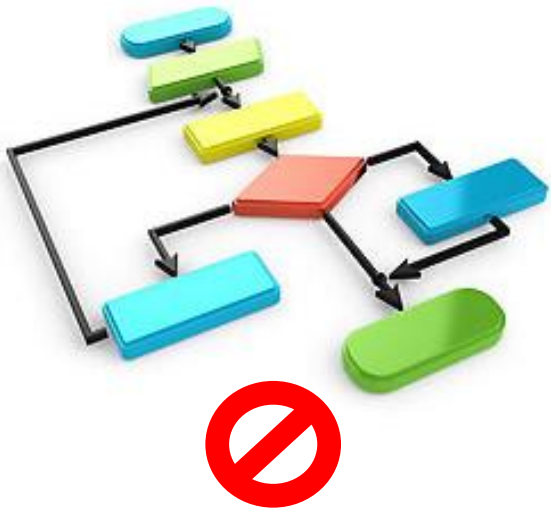
<https://cognitivecomputingconsortium.com/>



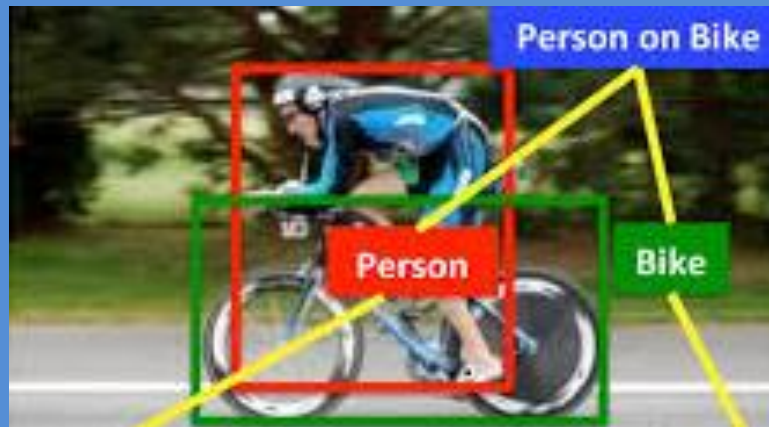
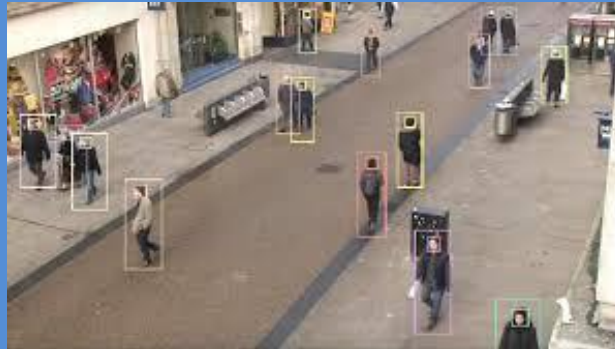
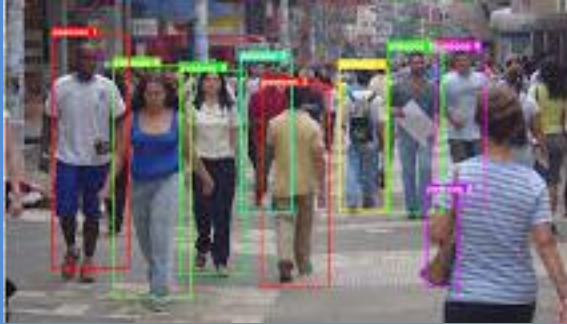
Atividade complexa?



Problema complexo?

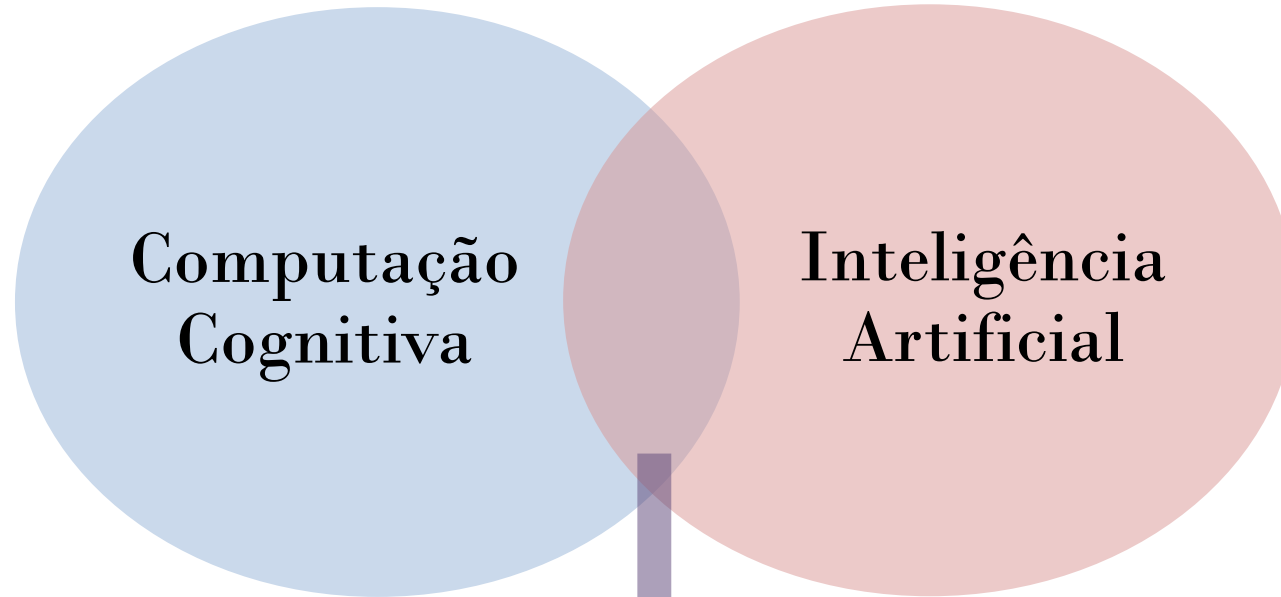


Contexto Computável



Contexto Computável

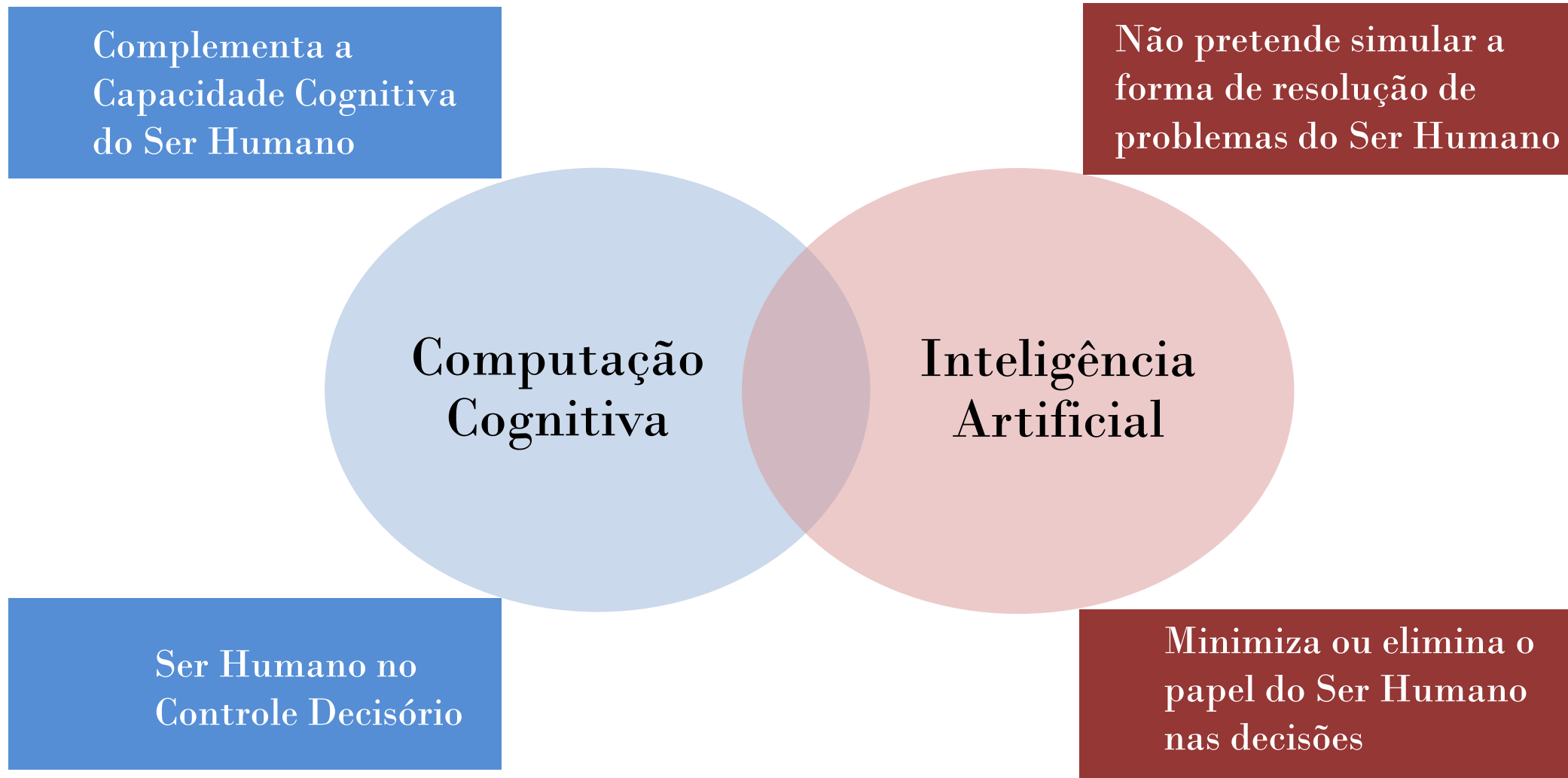




Atividades ou problemas complexos

Mesmos fundamentos científicos e tecnológicos

DIFERENÇAS?

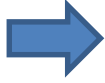




Sistema de Reconhecimento de Imagem

Computação Cognitiva?

Inteligência Artificial?



Pessoas







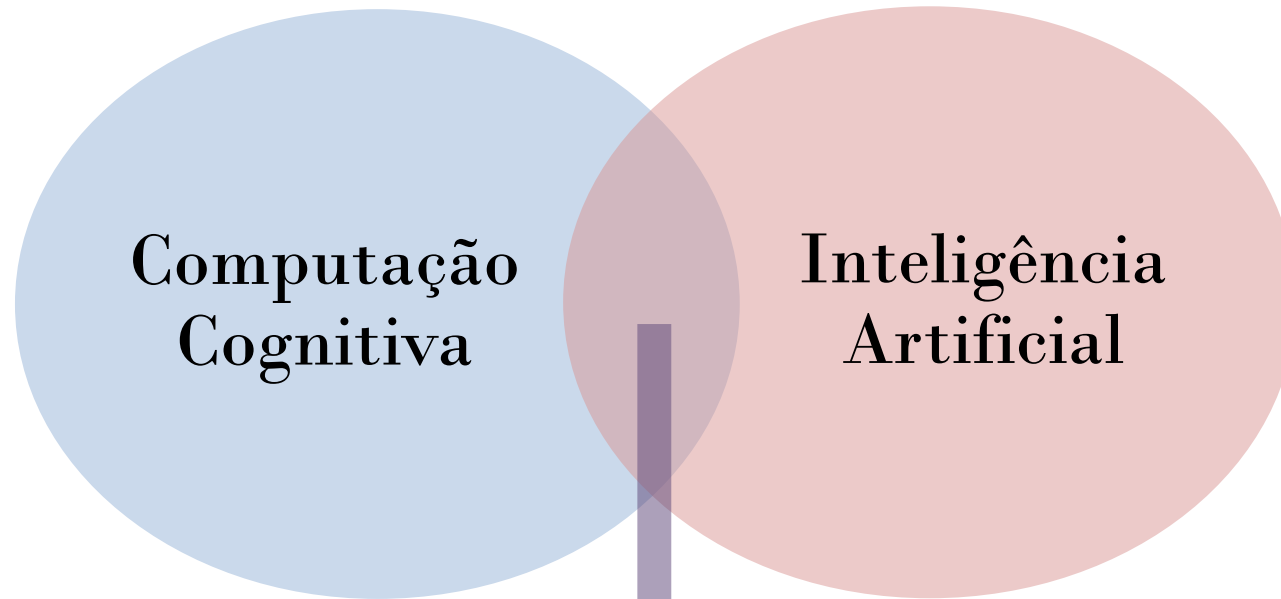
Papel Decisório - Inteligência Artificial





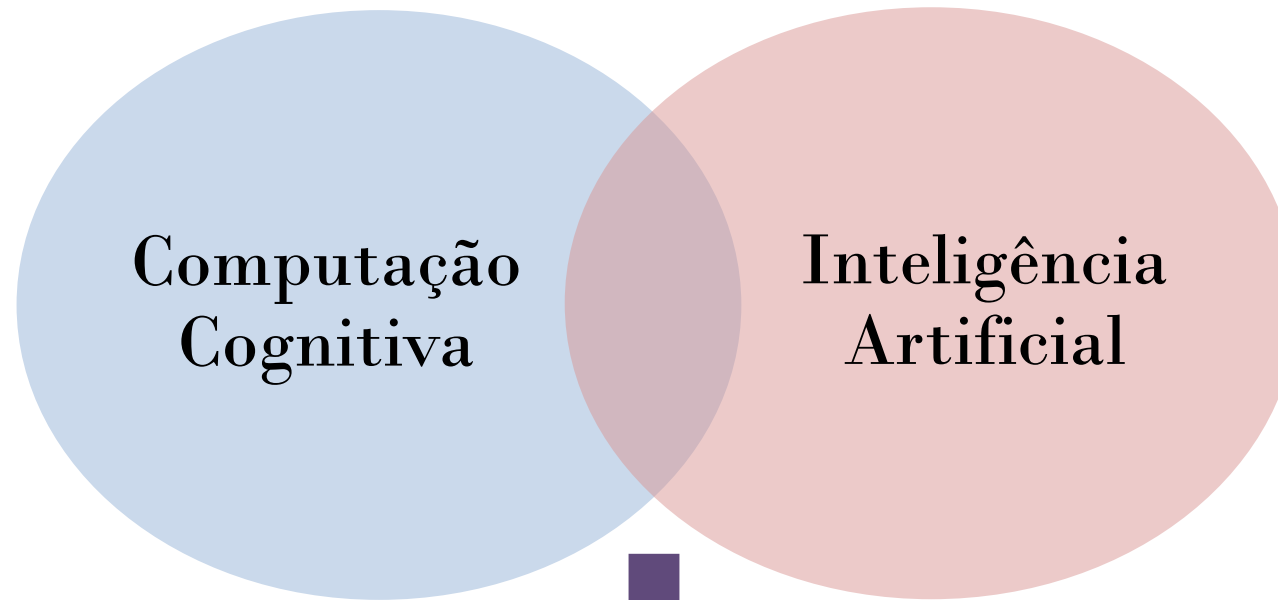
Grupo
ONCOCLINICAS
Sua vida. Nossa vida.





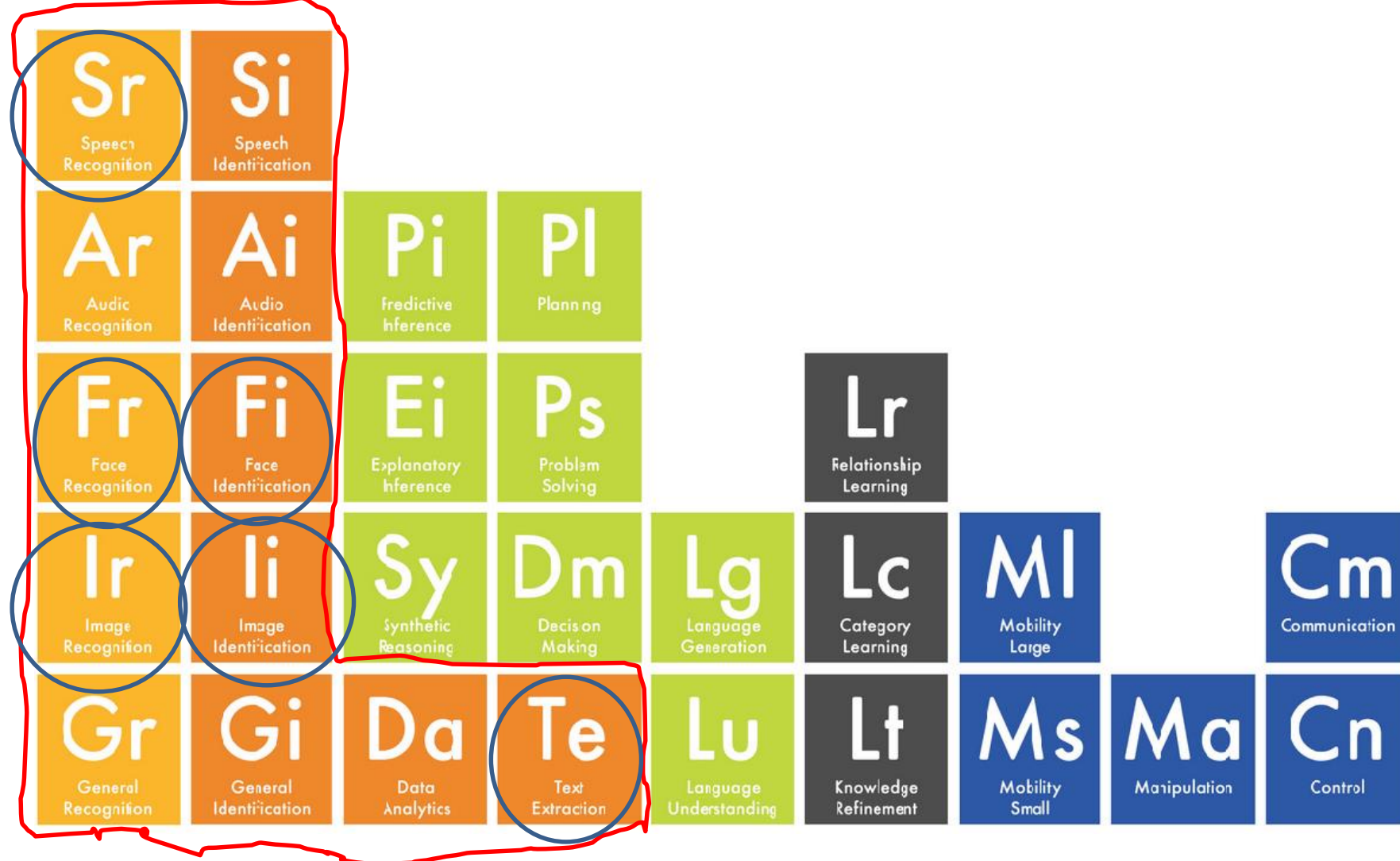
Solução de problemas complexos

Mesmos fundamentos científicos e tecnológicos

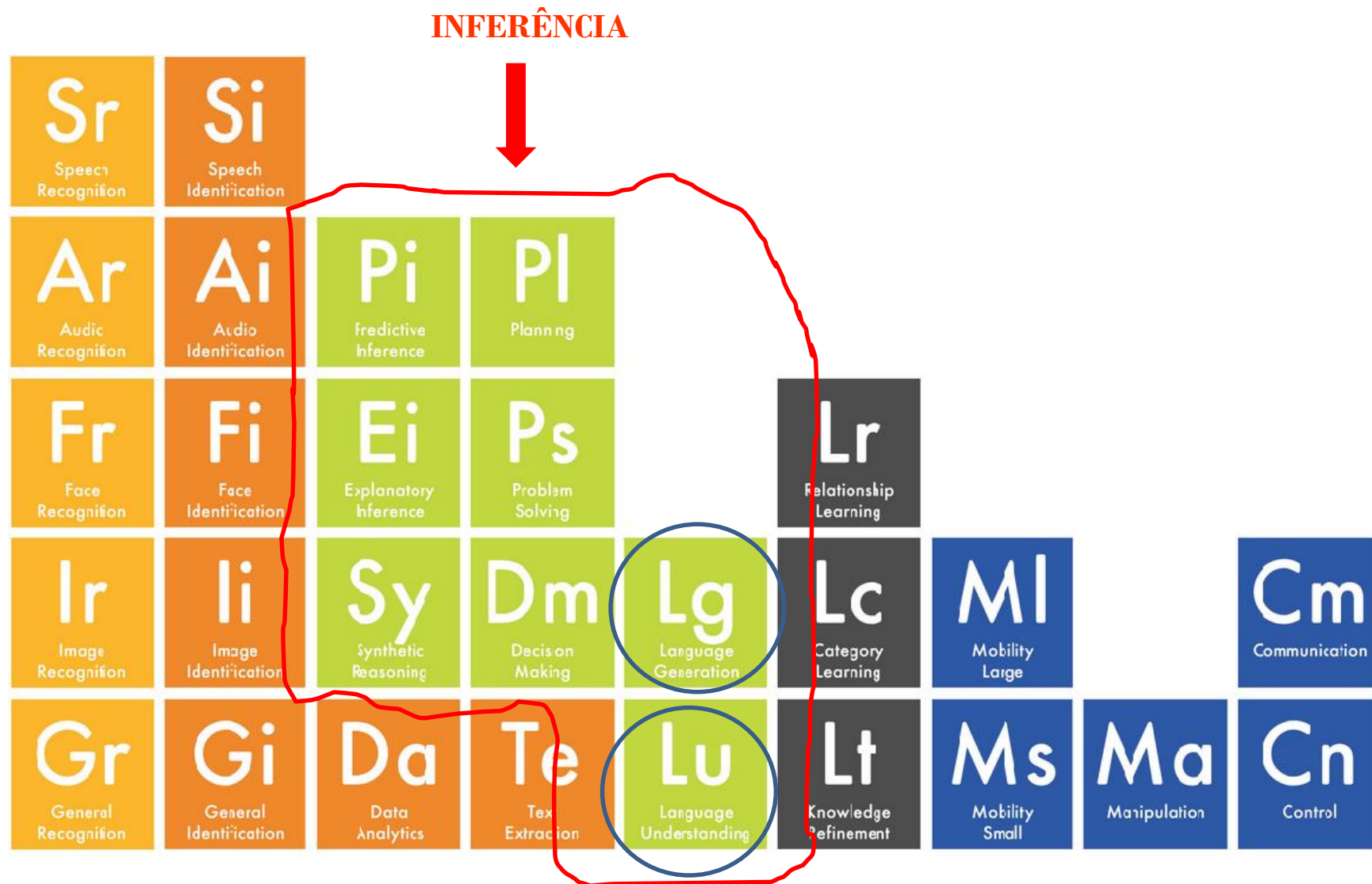


Sistemas Inteligentes – Blocos Construtivos

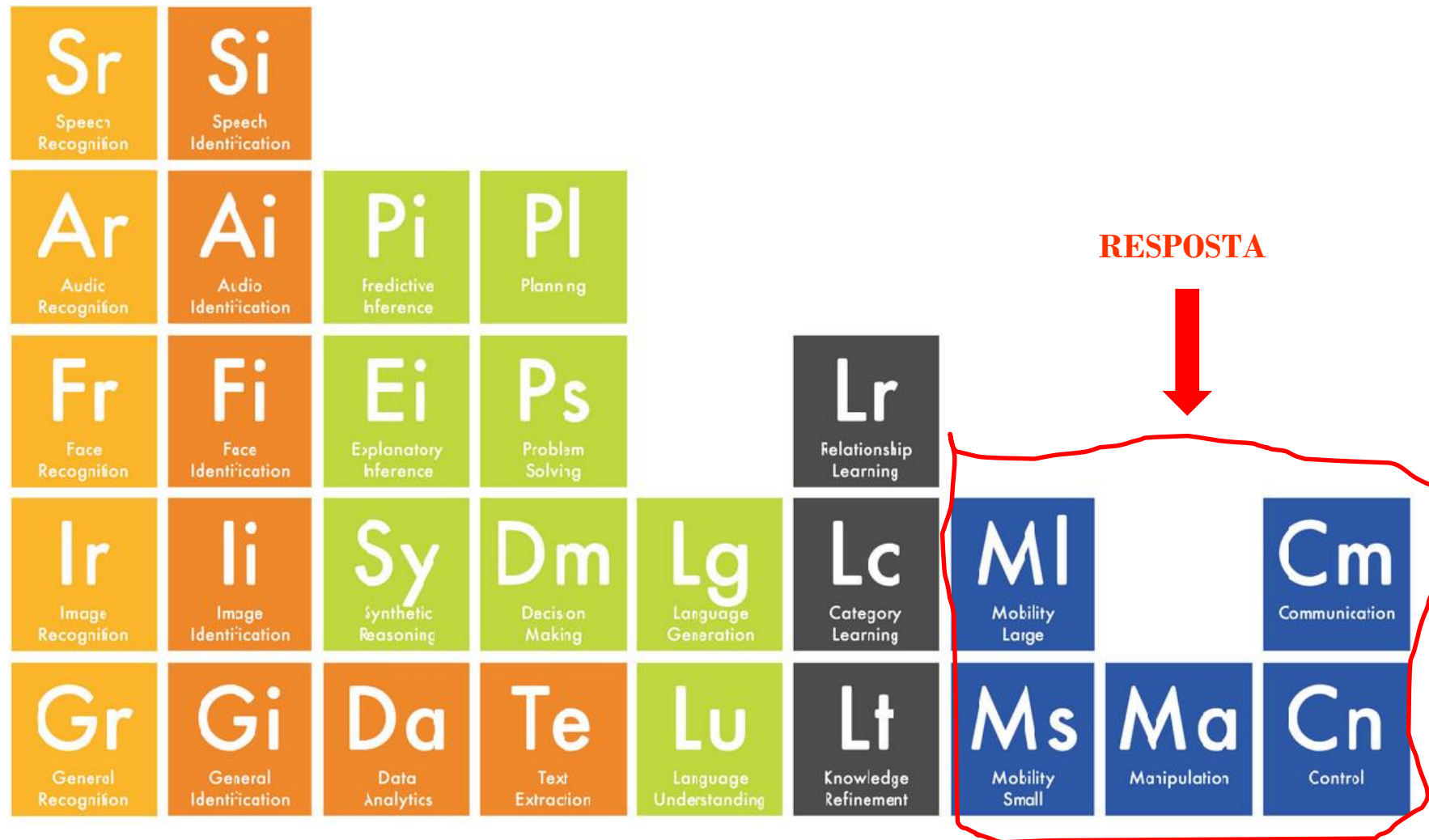
ENTRADA ou CAPTURA

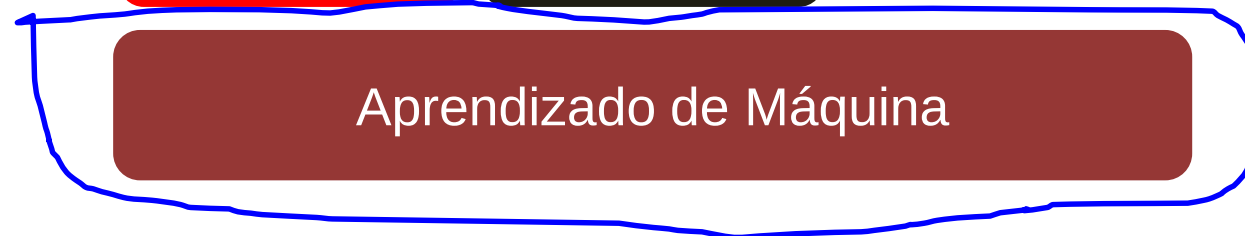
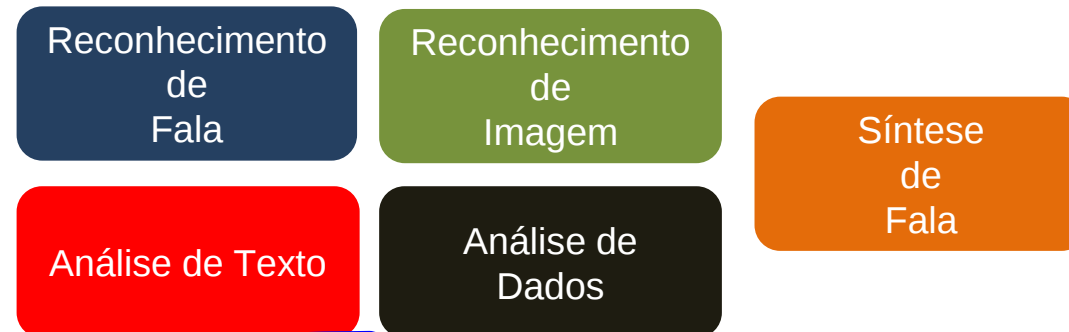
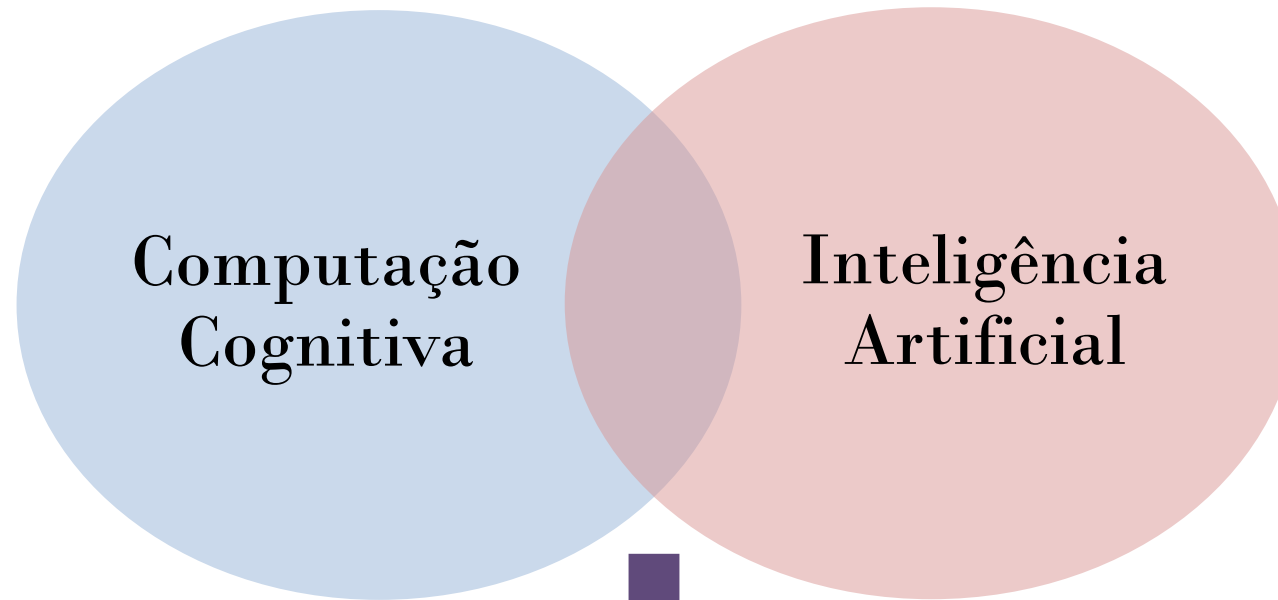


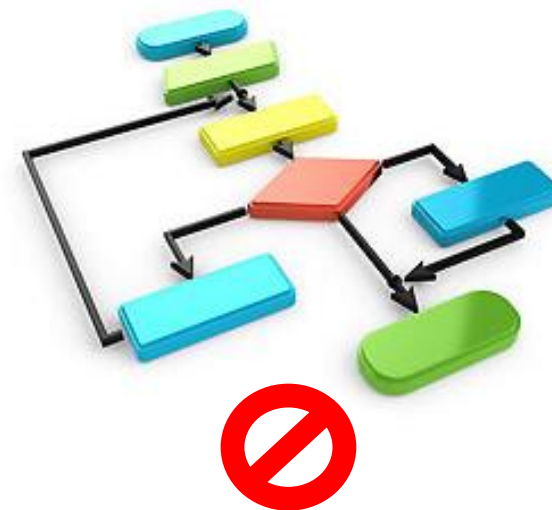
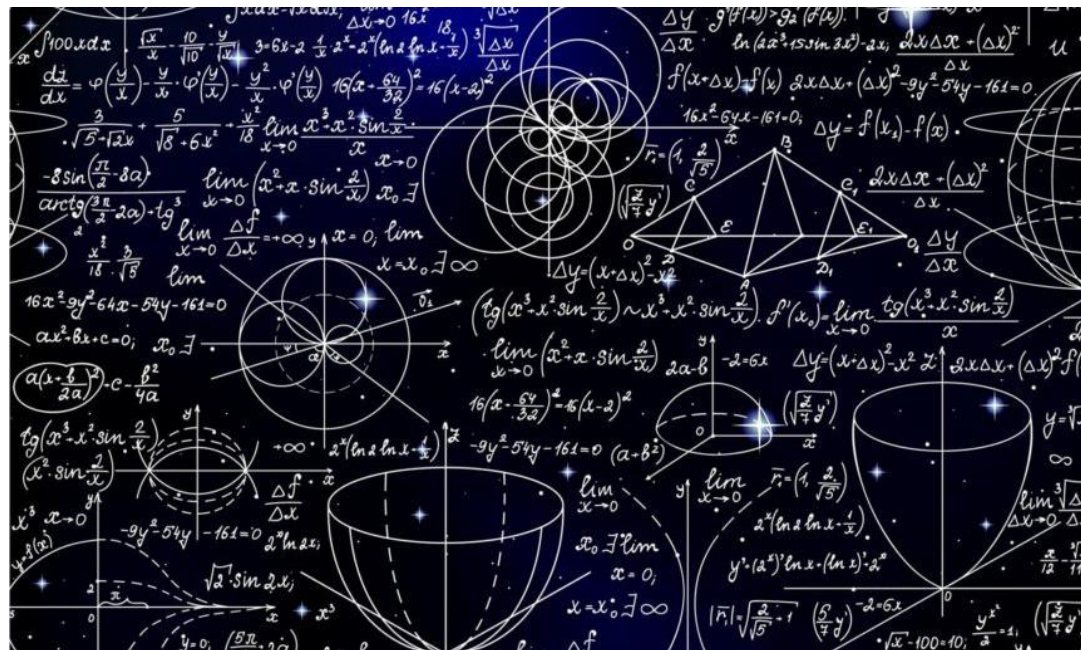
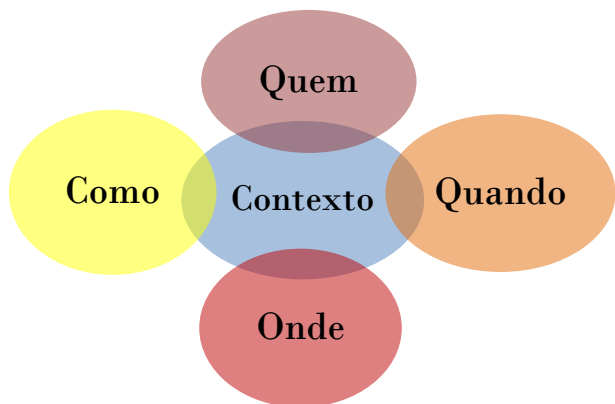
Sistemas Inteligentes – Blocos Construtivos



Sistemas Inteligentes – Blocos Construtivos

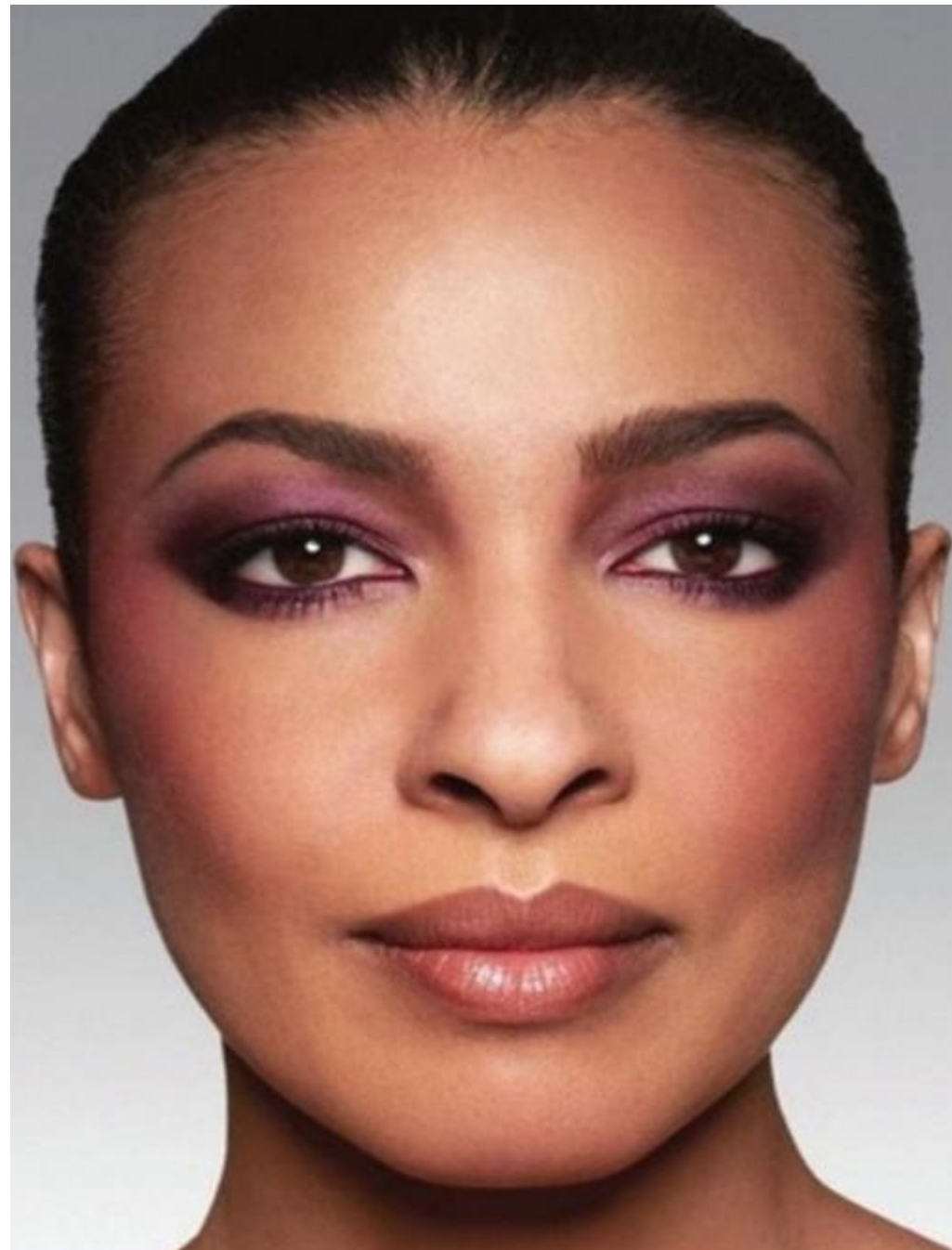


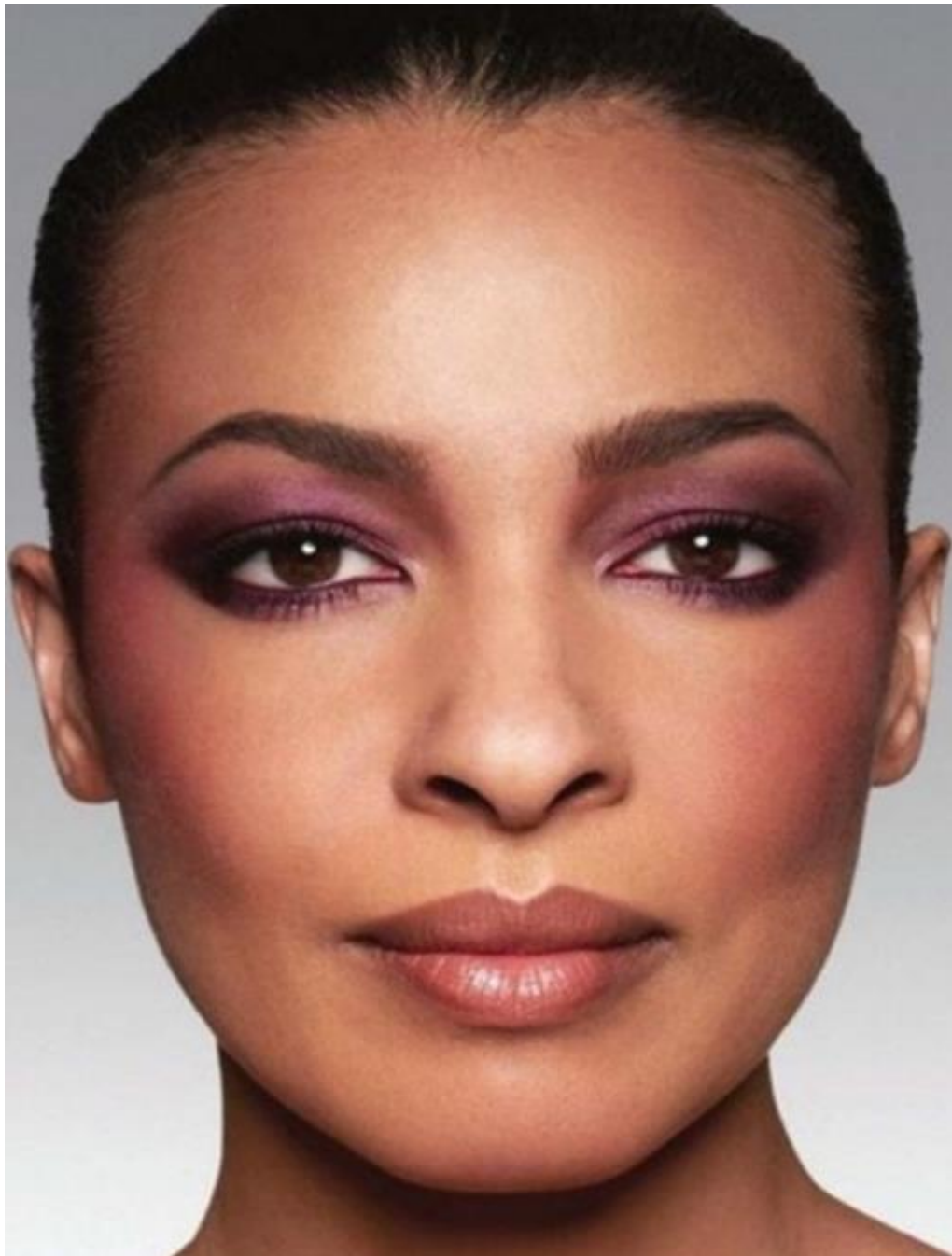






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0111	1111	1101	1111	1101	1101	1100	1111	1010	1101
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0101	1011	1101	1111	1101	1101	1100	1111	1010	1101
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0101	1001	1101	1111	1101	1111	1100	1111	1010	1001
0101	1001	1101	1001	1101	1111	1100	1111	1010	1101

Aprendizado de Máquina

Solução computacional que toma decisões baseadas em experiências acumuladas através da solução bem sucedida de problemas anteriores

São capazes de adquirir conhecimento de forma automática

Aprendizado de Máquina

Inferência Lógica Indutiva

Aprendizado Supervisionado

Indução

Casos Particulares

Observação

Reconhecimento de Padrões

Cria Generalizações

Aplica a novos dados



Indução Matemática

$$f(n)^2 = n^2 - n + 41$$

Conjunto Exemplo

$$n = 1 \quad f(1) = 41$$

$$n = 2 \quad f(2) = 43$$

$$n = 3 \quad f(3) = 47$$

$$n = 4 \quad f(4) = 53$$

$$n = 40 \quad f(40) = 1.601$$

$$n = 41 \quad f(41) = 41^2 \quad \text{Não é primo!}$$

Generalização

$$f(n)^2 = n^2 - n + 41$$



$f(n)$ = Número Primo

Treinamento Supervisionado



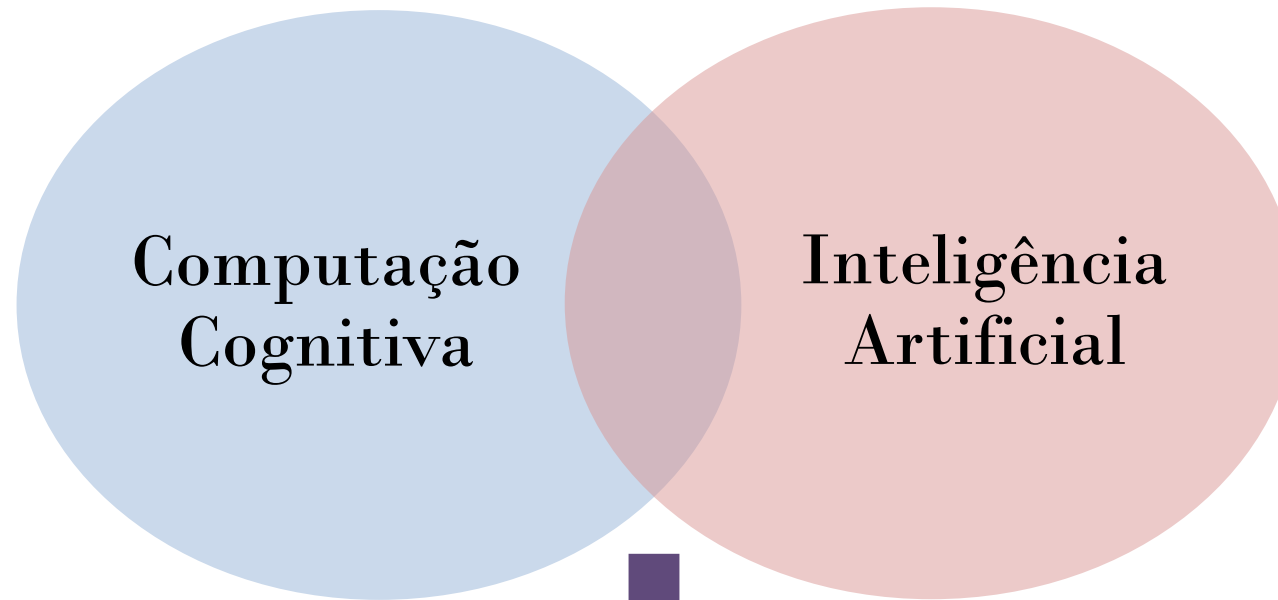
Treinamento Supervisionado



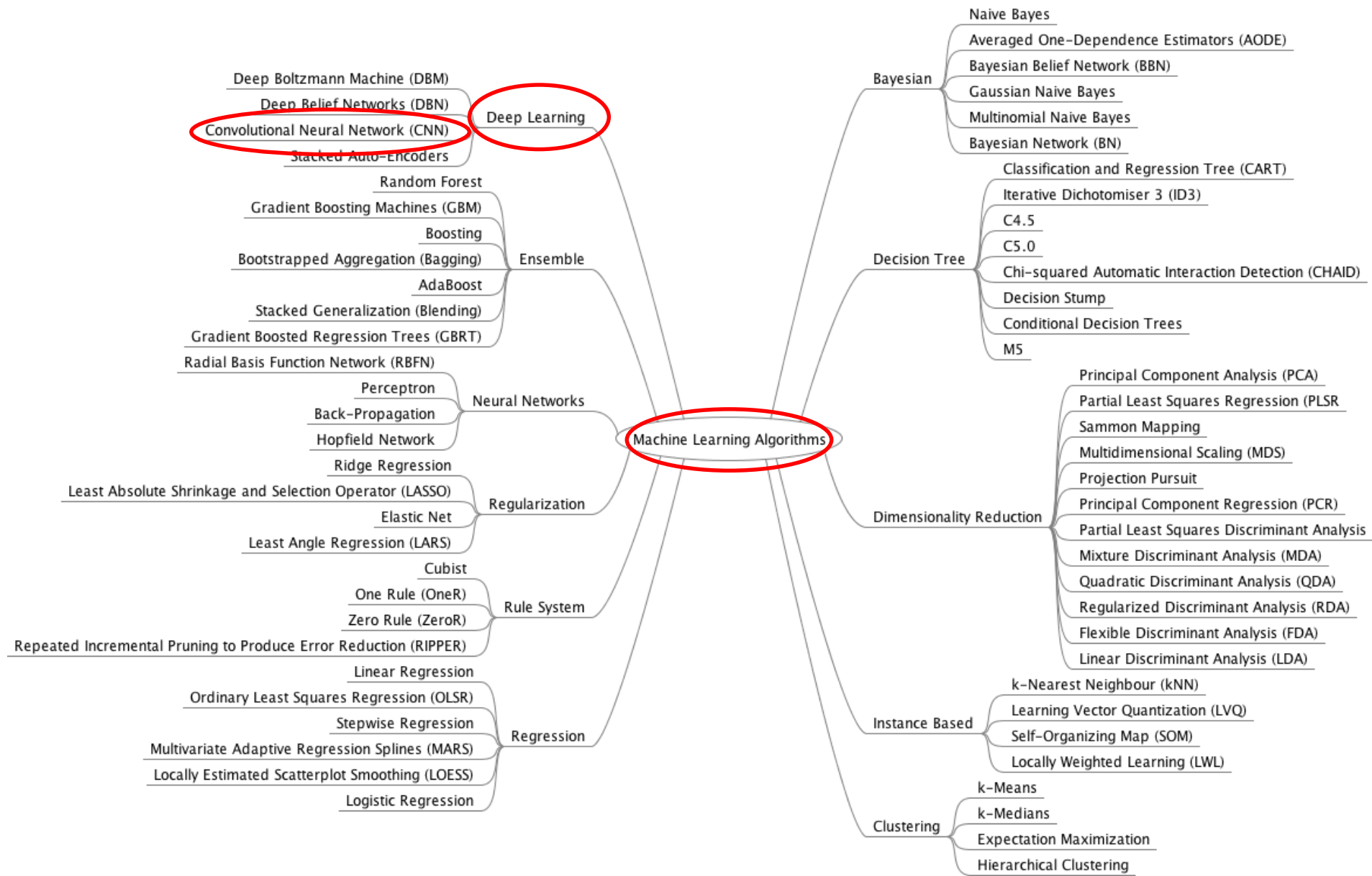
Treinamento Supervisionado

x

Treinamento Não Supervisionado

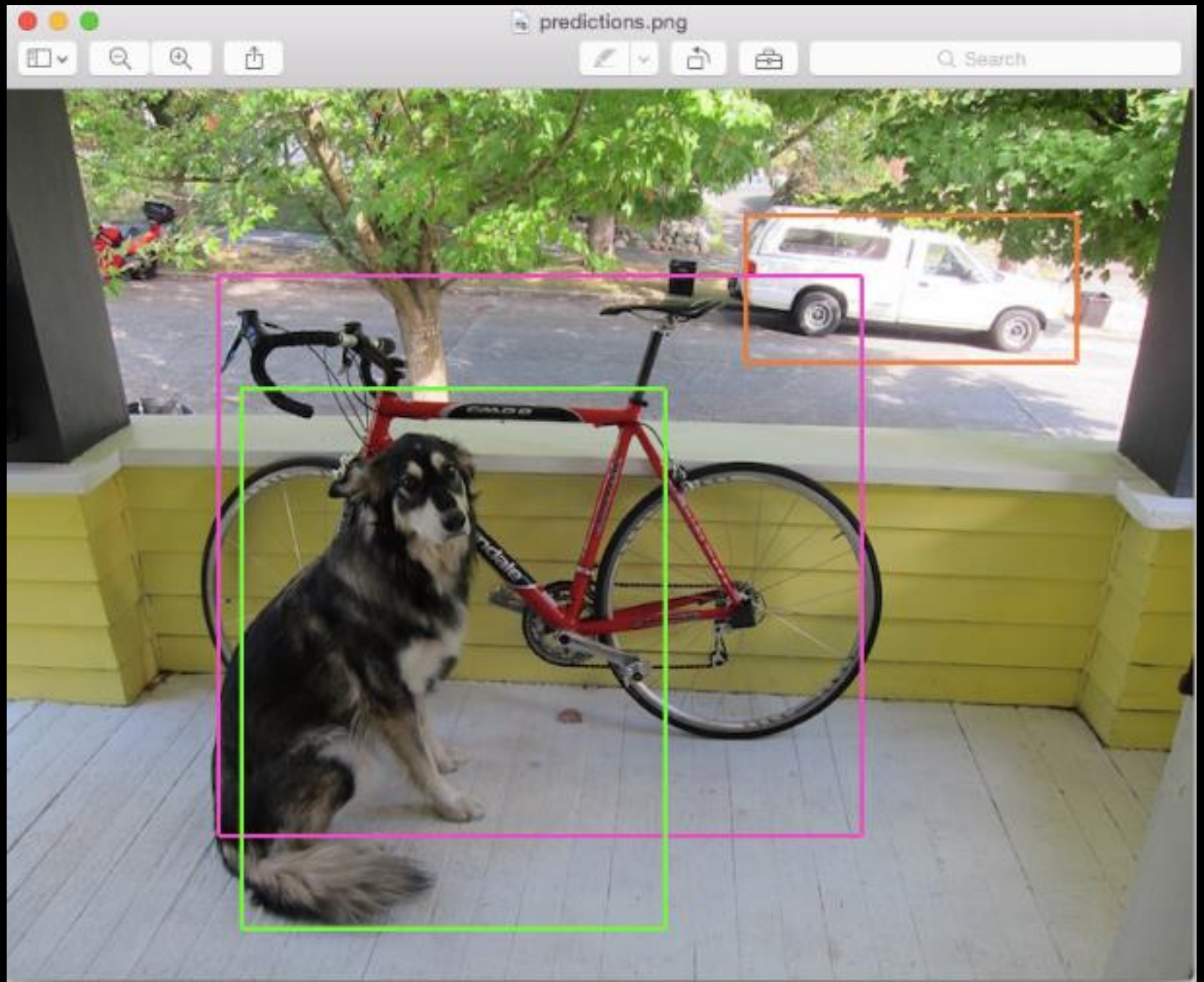


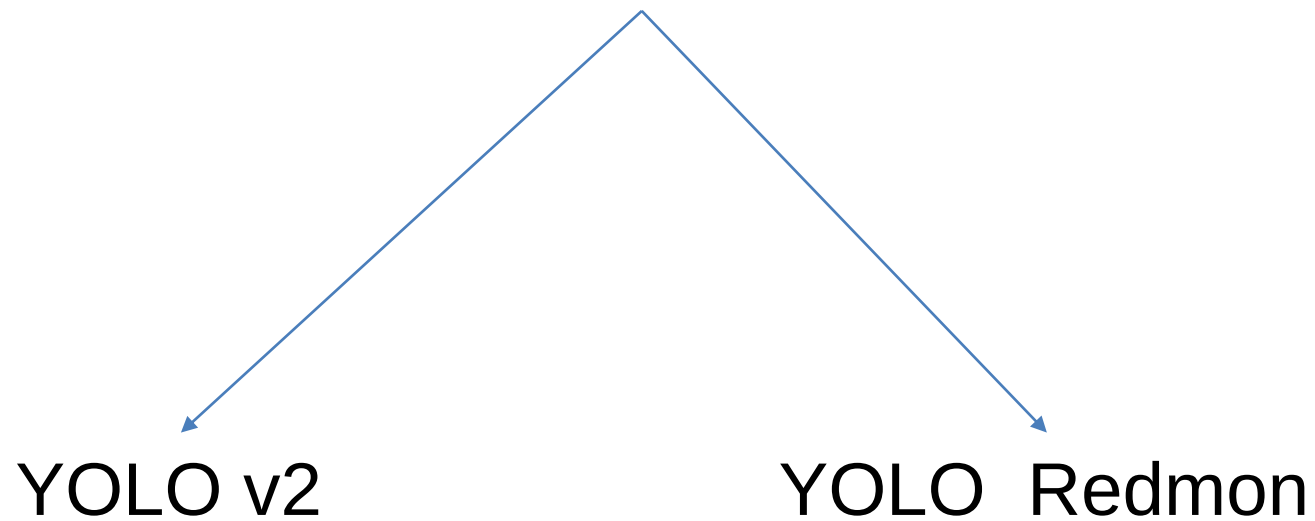
Formas de Implementação



YOLO

Real Time Object Detection





You Only Look Once

person



clock



Um exemplo...

Compreender e responder à linguagem natural

Analisar uma massa gigantesca de dados

Encontrar a melhor resposta possível para qualquer pergunta

Eficiente, sistemático, mas não algorítmico

IBM Watson em Jeopardy!



IBM Deep Blue x Kasparov



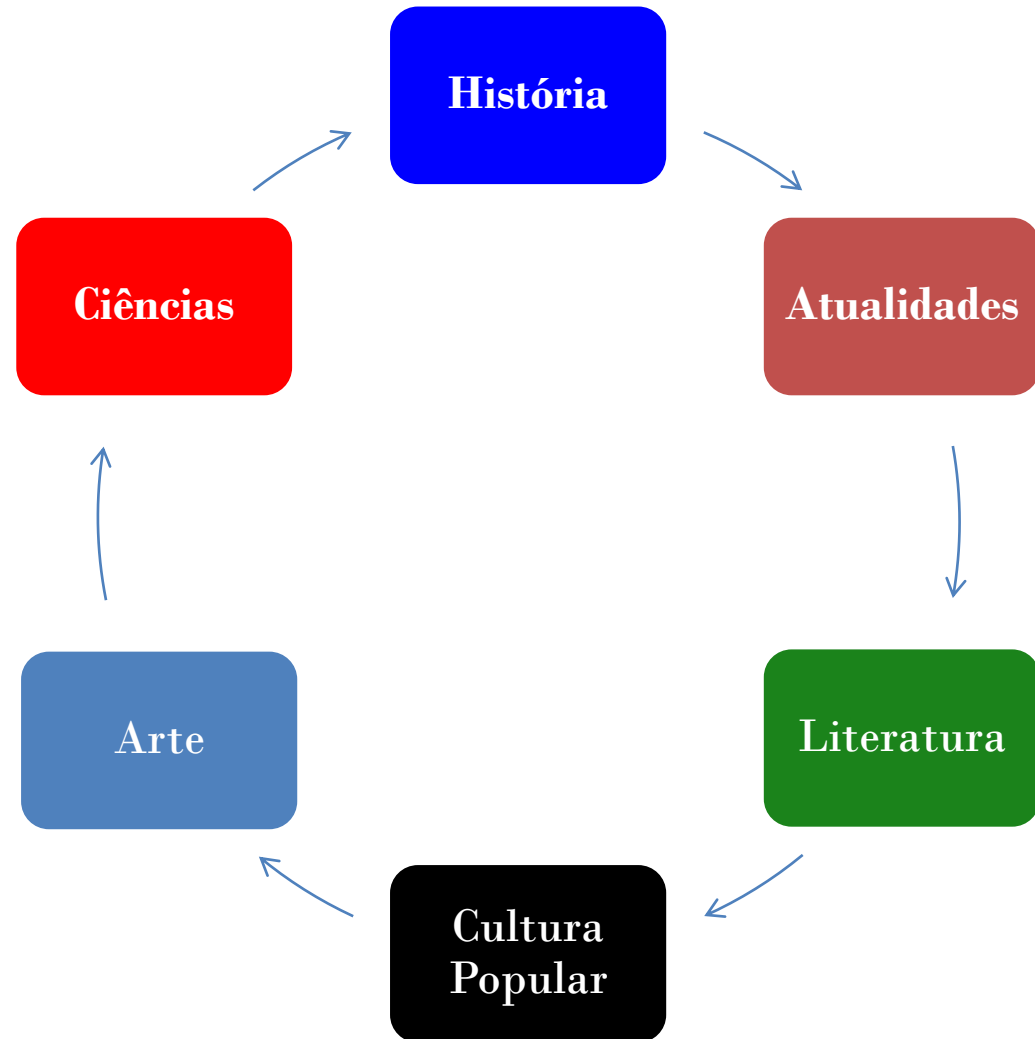
IBM Deep Blue x Kasparov



IBM Deep Blue x Kasparov



Jeopardy!





Jeopardy!



A primeira pessoa mencionada pelo nome em “O Homem da Máscara de Ferro” é o herói de um livro anterior do mesmo autor.

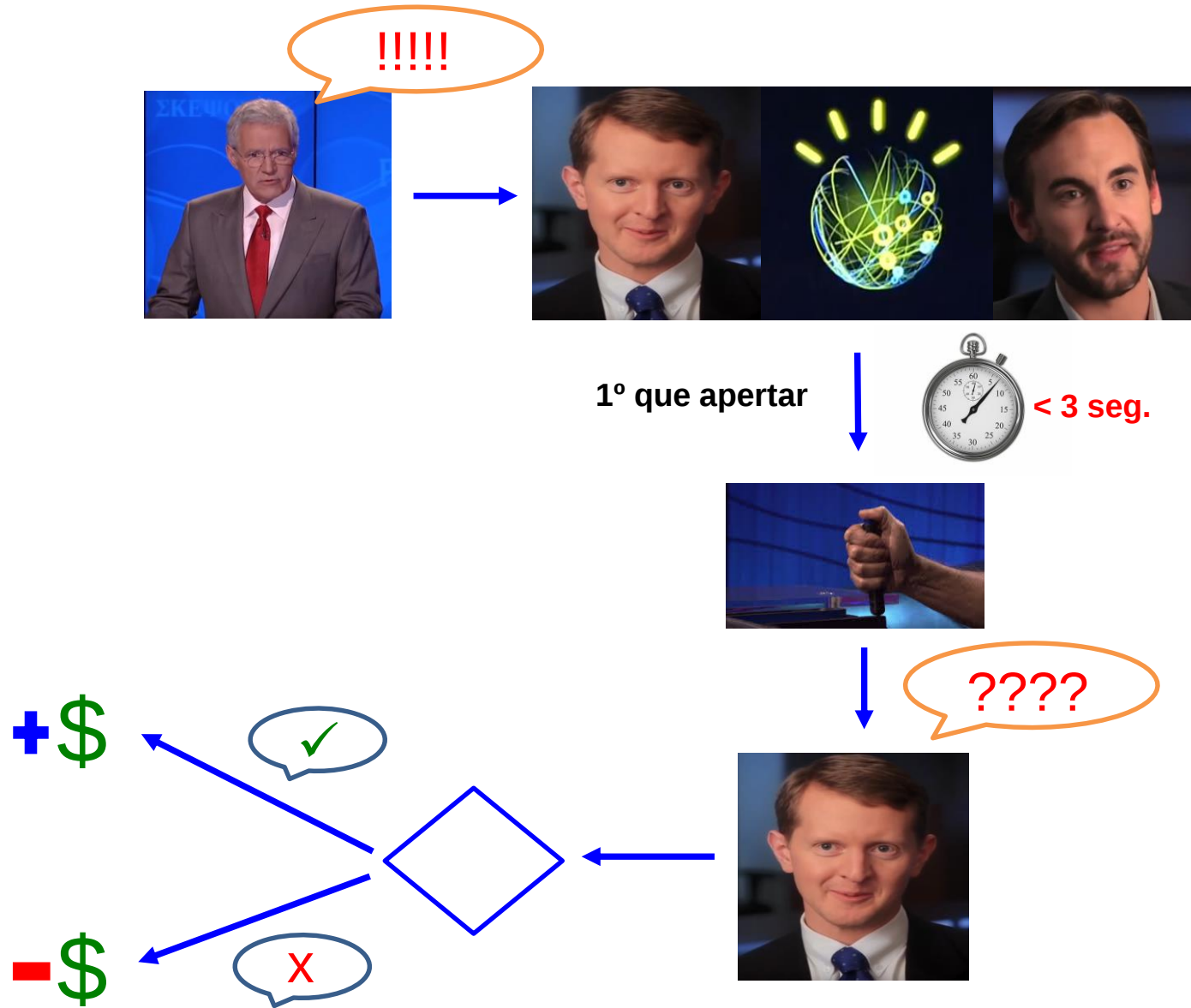


Literatura

Quem é D'Artagnan?

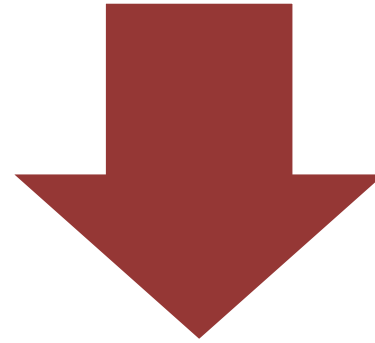


Regras do Jeopardy!



Outras Regras e Dinâmicas

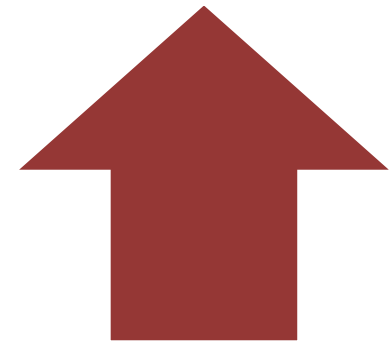
Tempo de
Resposta



+\$



< 3"

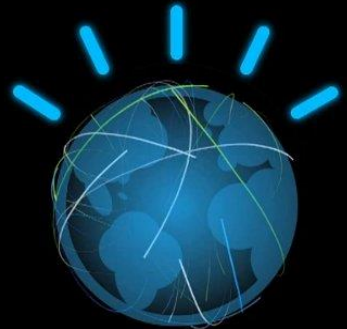


Precisão

Bastidores de uma resposta...

ou na modéstia habitual da IBM:

“The Science behind an answer”



IBM Watson

Arquitetura DeepQA

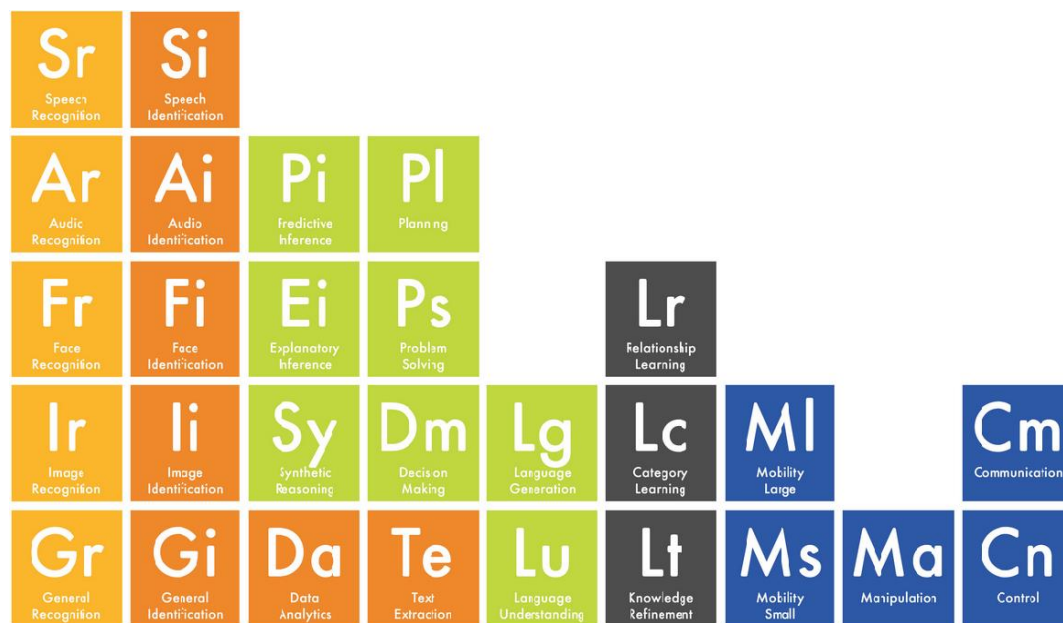
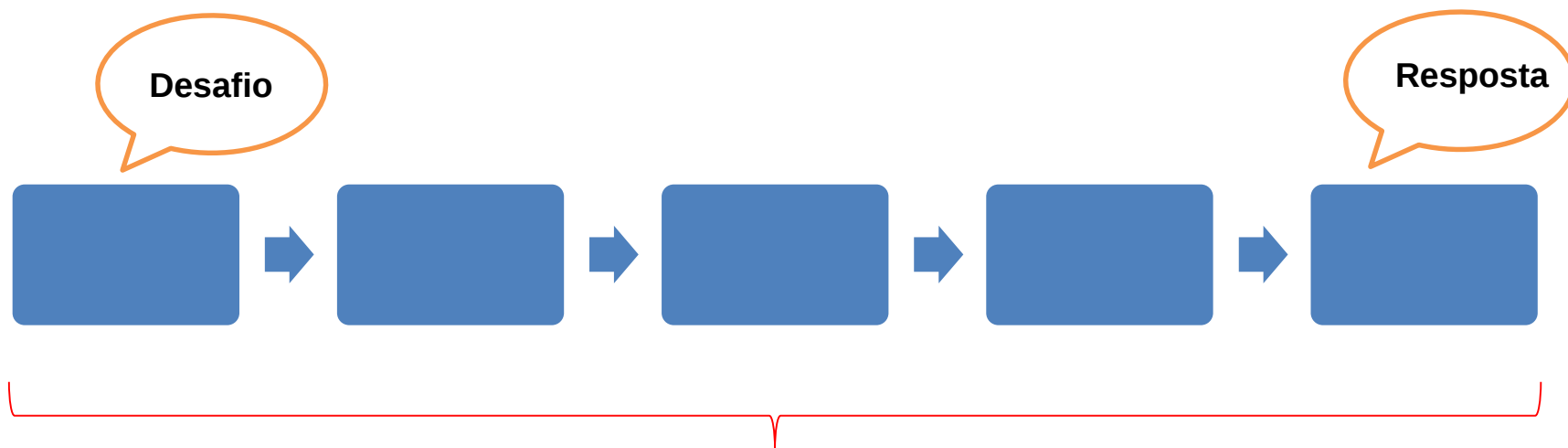
Deep Learning

Query & Answer

Arquitetura DeepQA



Arquitetura DeepQA

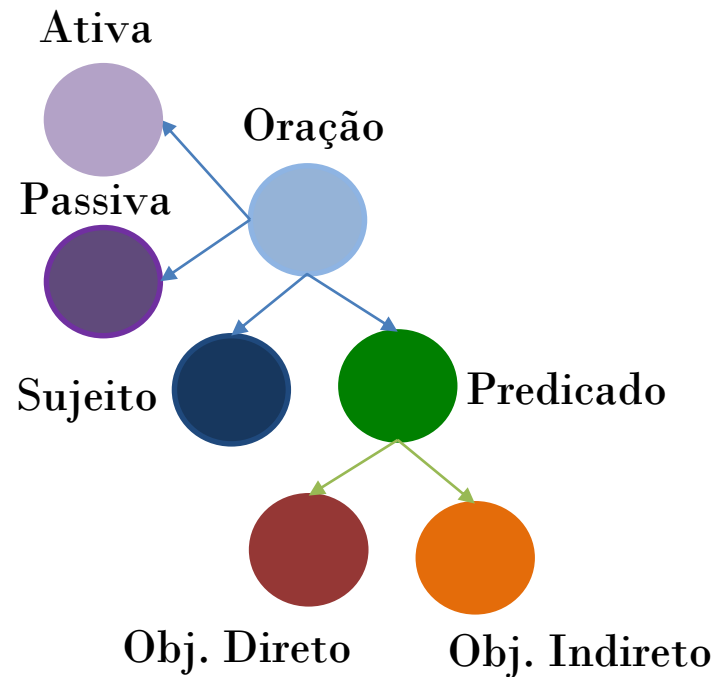


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A primeira pessoa mencionada pelo nome em “O Homem da Máscara de Ferro” é o herói de um livro anterior do mesmo autor.

Question
Analysis



Primeira pessoa { mencionada em
“O Homem da Máscara de Ferro”

é

herói { livro anterior
do mesmo autor

A primeira pessoa mencionada pelo nome em “O Homem da Máscara de Ferro” é o herói de um livro anterior do mesmo autor.



Palavras chaves: nome, homem, máscara, ferro, livro, heróis, autor,

Relações: pessoa ↔ nome

livro ↔ título

Lugares: n/a

Datas: n/a

Tipo de pergunta: factual ➡ **Resposta:** Entidade

LAT (Tipo Léxico da Pergunta): Nome de Pessoa

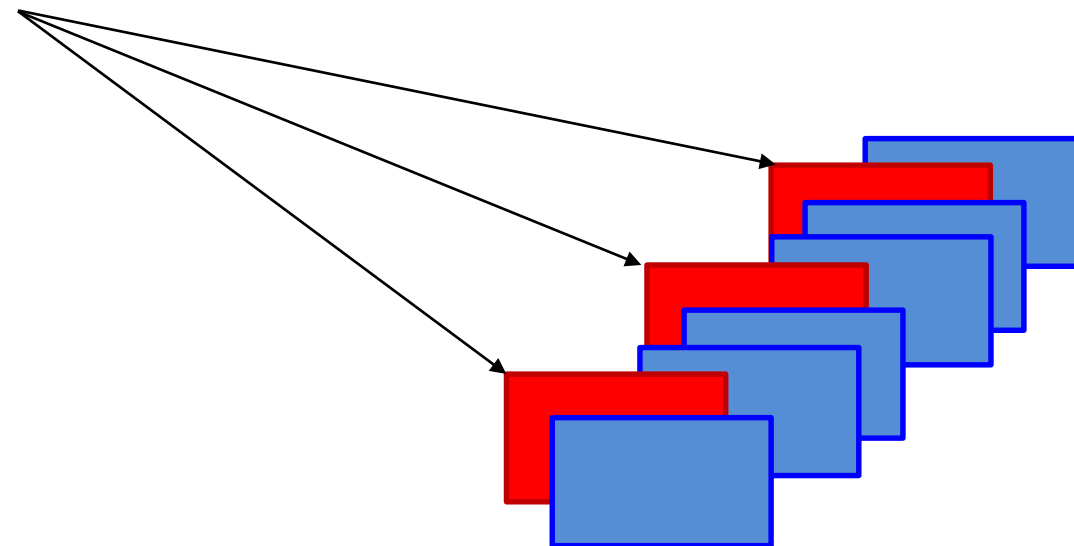
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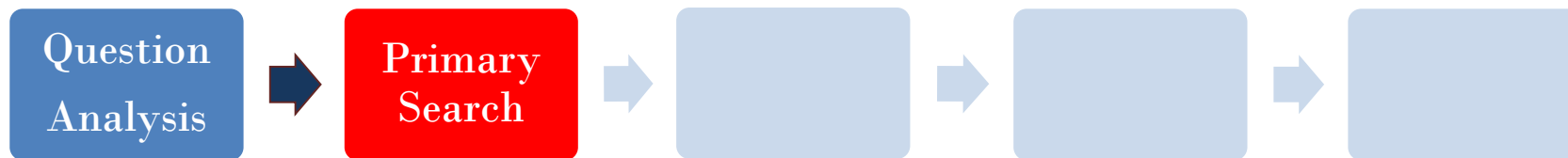




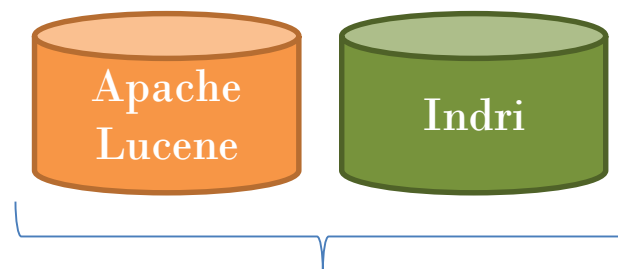


Documentos ou trechos
com
Resposta Candidatas

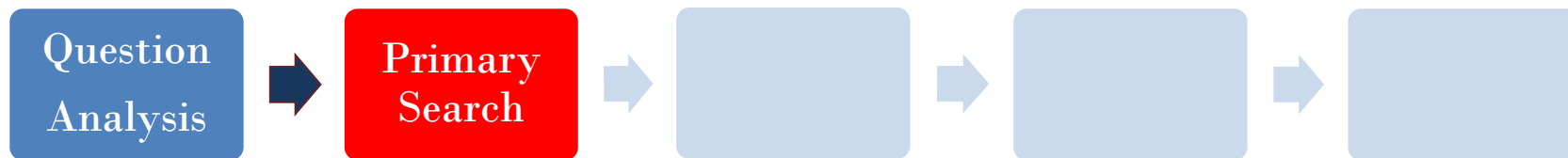




livro **AND** “homem da máscara de ferro” **AND** herói **AND** autor **AND**.....



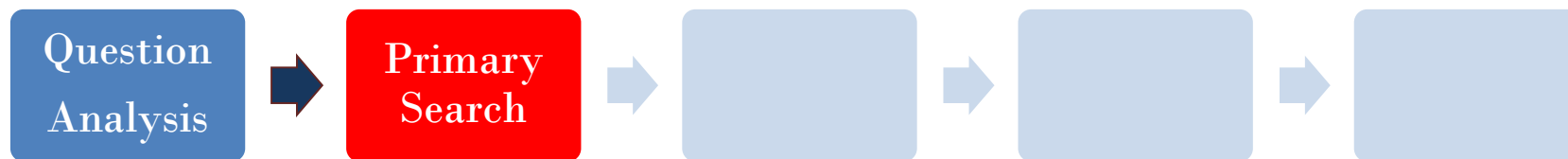
- Enciclopédias
- Dicionários
- Tesouros
- Trabalhos literários
- Artigos de imprensa
- Wikipedia



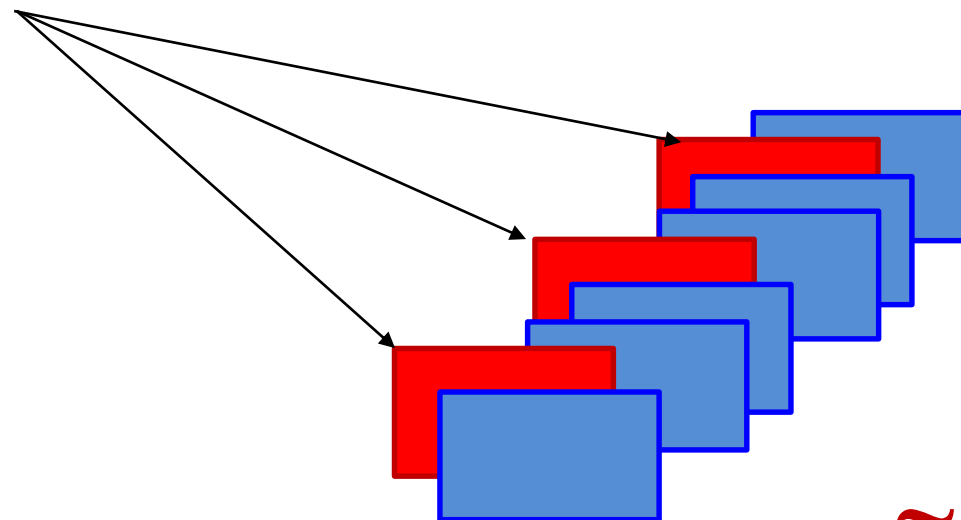
Consulta **SQL** ou **SPARQL**



- BD Relacionais
- Taxonomias
- Ontologias
- DBpedia

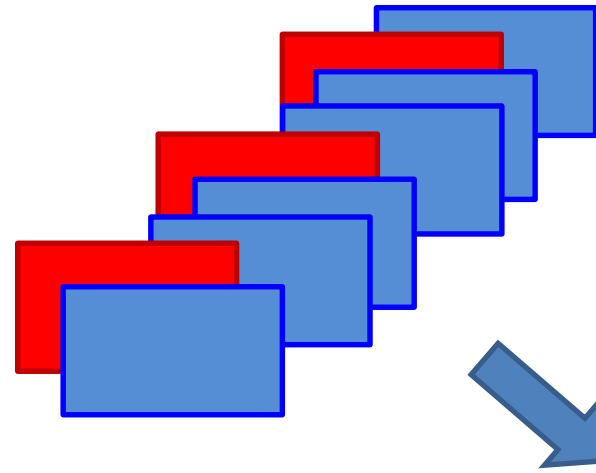
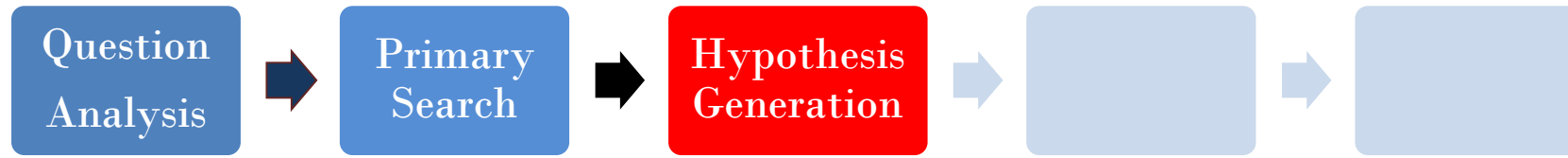


Documentos ou trechos
com
Resposta Candidatas

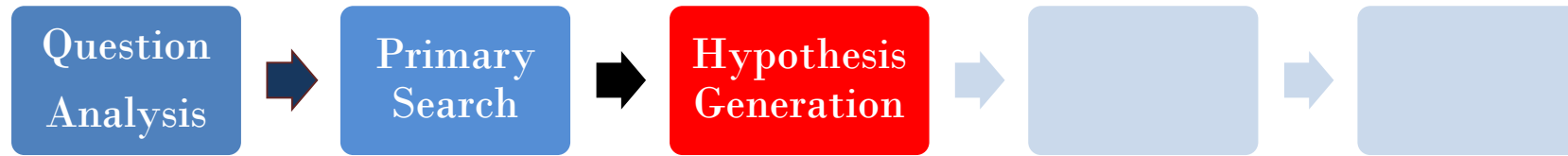


~x00





Geração das Respostas Candidatas
(Hypothesis Generation)



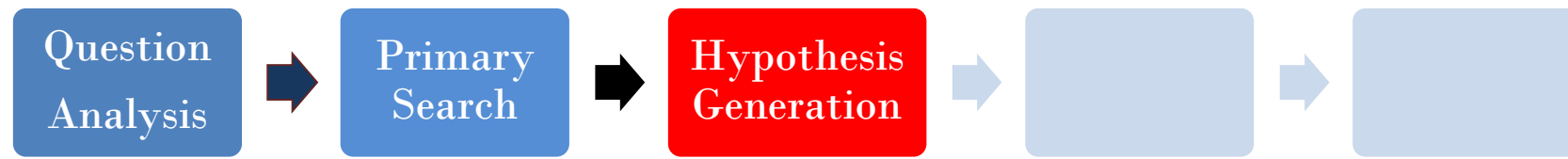
Maior número possível de respostas candidatas



Menor intervalo de tempo

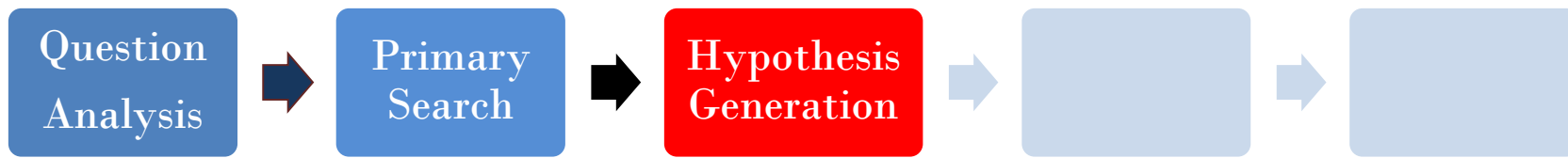


Garantir que a resposta correta não fique fora do conjunto



Tipo de pergunta: factual

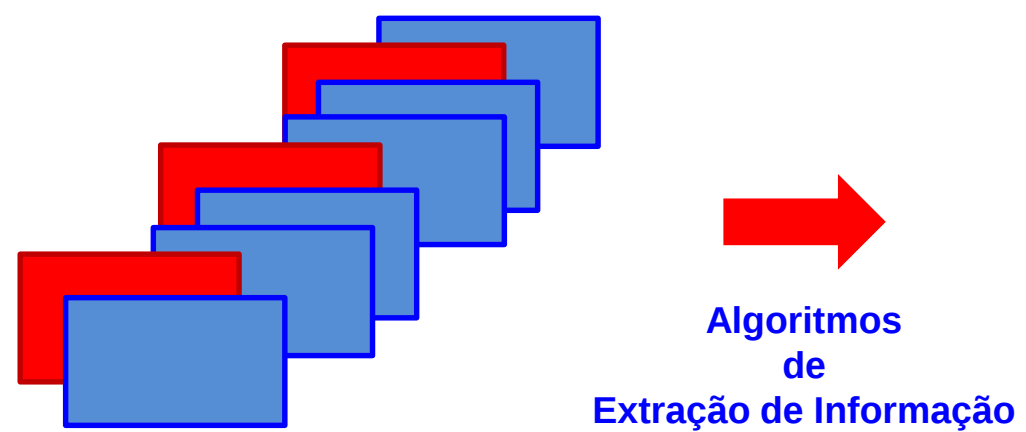
Resposta esperada: nome de uma entidade

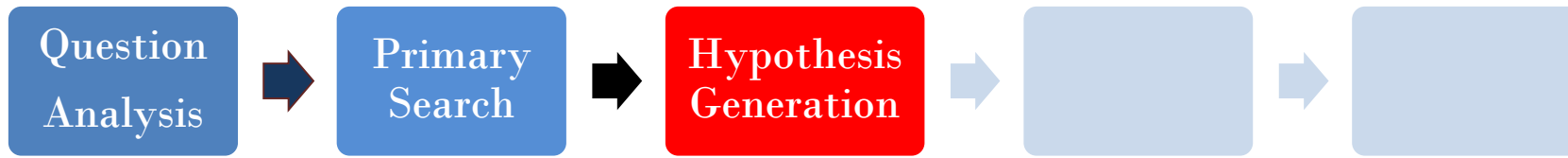


Respostas Candidatas

Os Três Mosqueteiros
DiCaprio
O Conde de Monte Cristo
Aramis
Alexandre Dumas
D'Artagnan
Gerard Derpadieu
.....

~x00



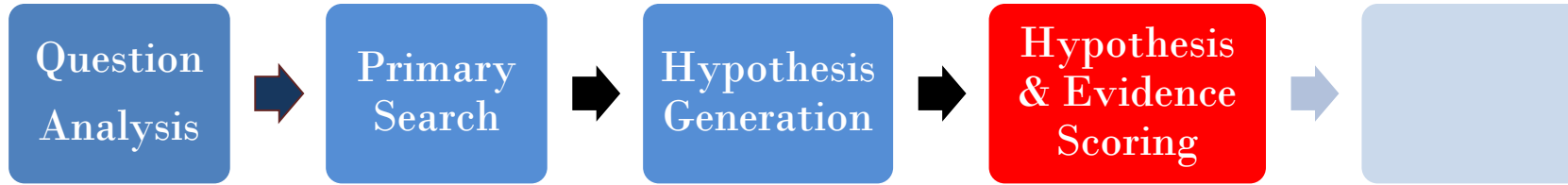


Respostas Candidatas

Os Três Mosqueteiros
DiCaprio
O Conde de Monte Cristo
Aramis
Alexandre Dumas
D'Artagnan
Gerard Derpadieu
.....

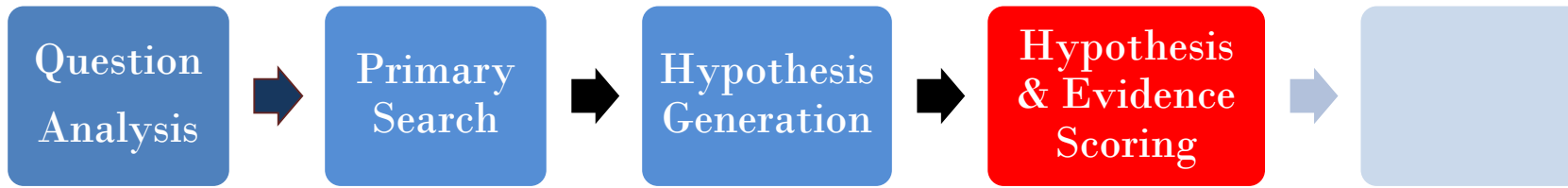
Qual é a correta?

~x00



Competição entre as resposta candidatas

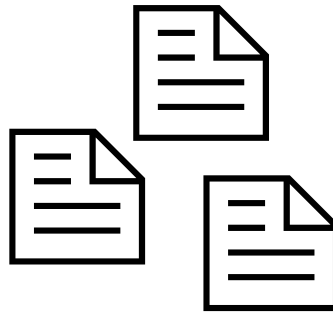
Qual delas é a mais relevante?



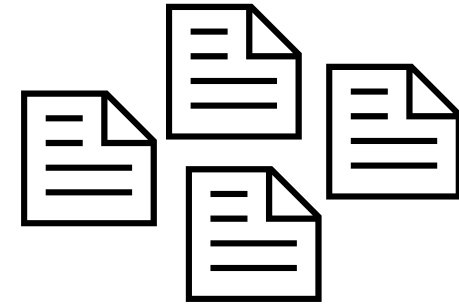
Coleta
de
Evidências

~x0

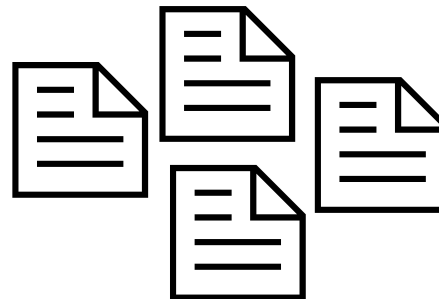
Alexandre Dumas



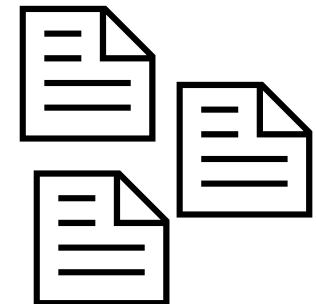
Os Três Mosqueteiros

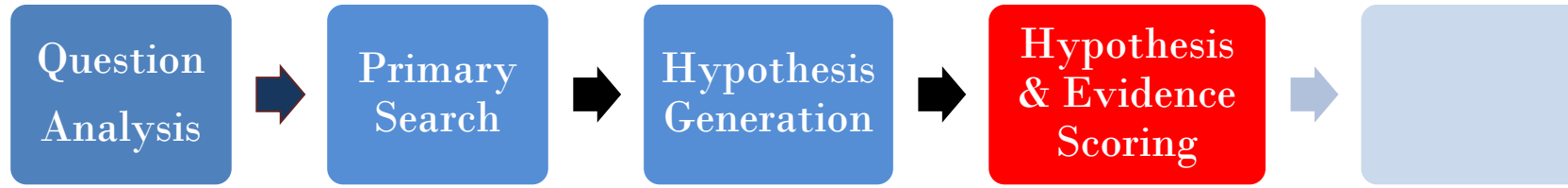


D'Artagnan



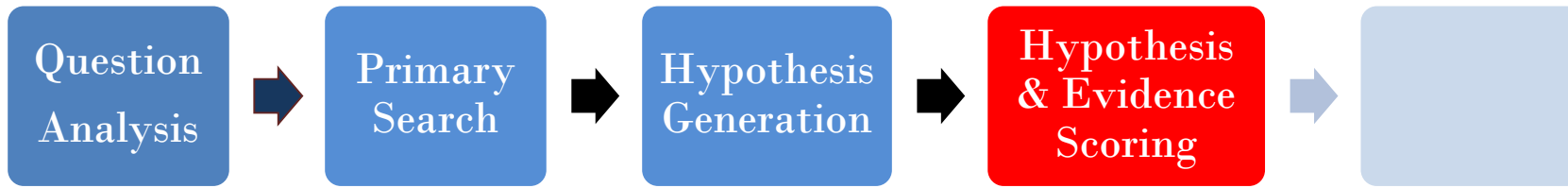
DiCaprio



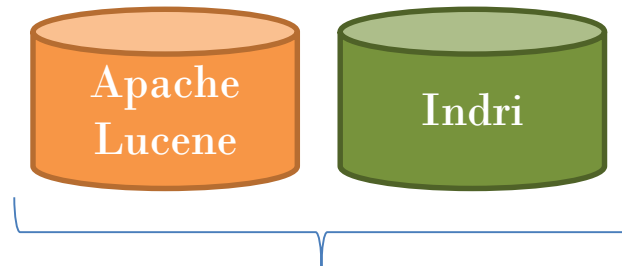


Como ele descobre essas evidências?

Outra rodada de recuperação de informação

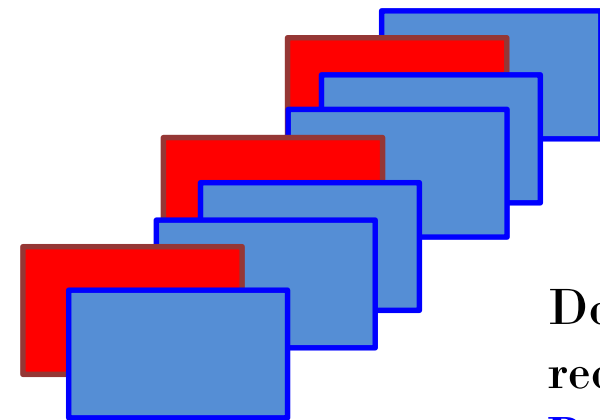


Resposta Candidata
~x00 { **DiCaprio** + { **AND** livro **AND** “homem da máscara de ferro” **AND** herói **AND**.....

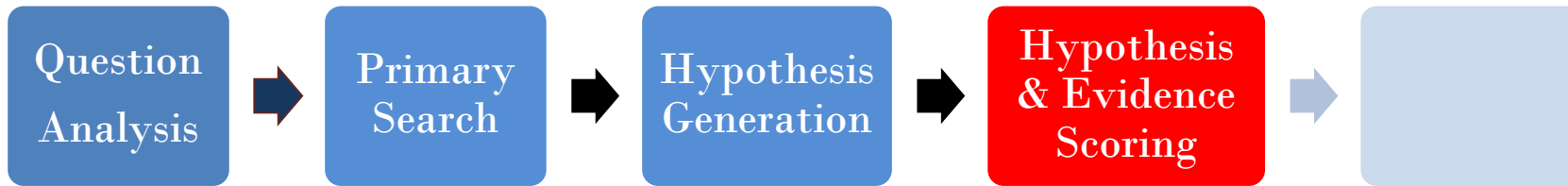


- Enciclopédias
- Dicionários
- Tesouros
- Trabalhos literários
- Artigos de imprensa
- Wikipedia

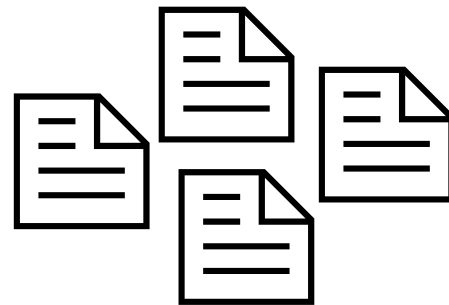
+



Documentos recuperados no
Primary Search



Limpeza



Evidências

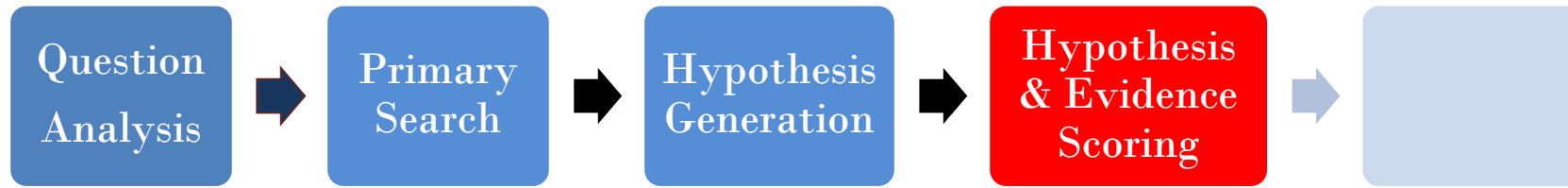


Os Três Mosqueteiros

≠



LAT (Lexical Answer Type): **NOME DE PESSOA**

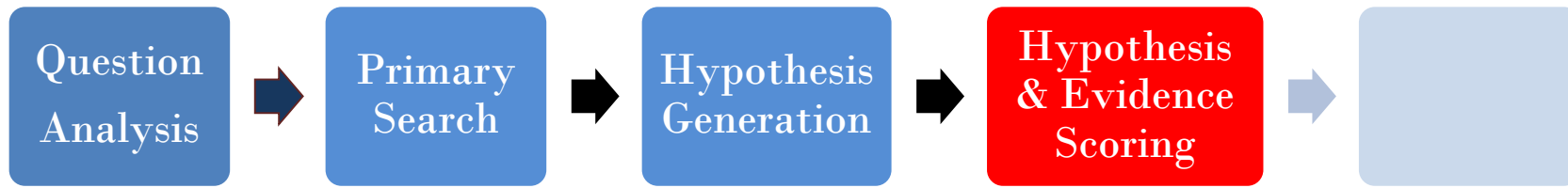


E a competição?

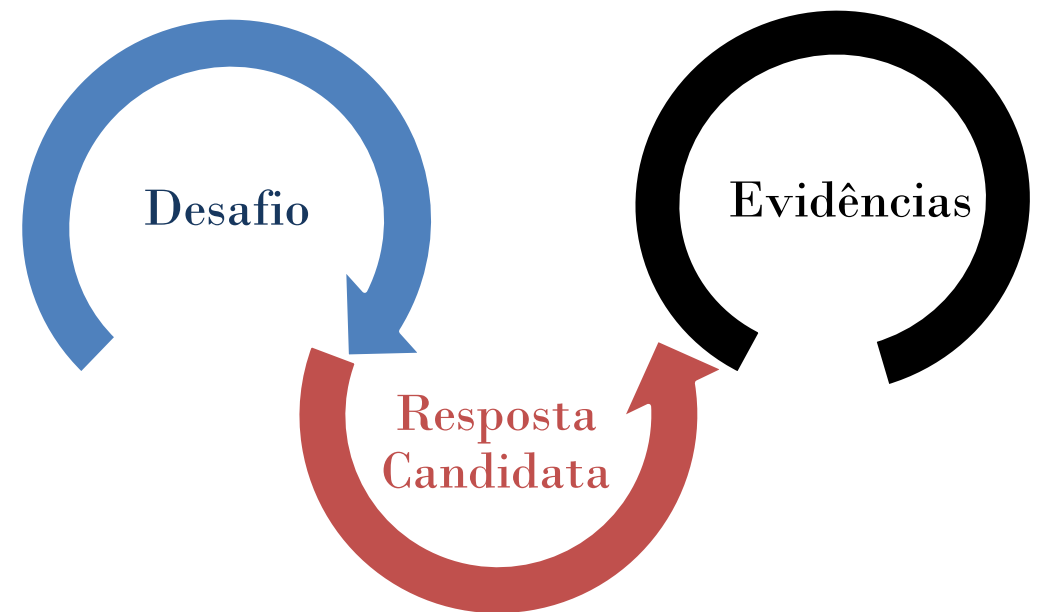
Como pontuar?

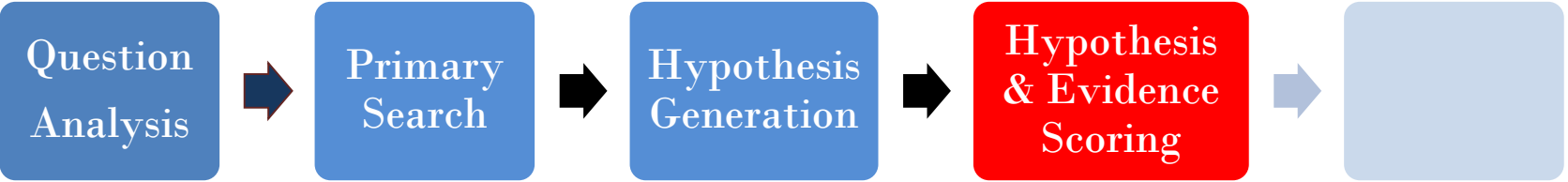
Qual é a correta?

Respostas Candidatas
Os Três Mosqueteiros
DiCaprio
O Conde de Monte Cristo
Aramis
Alexandre Dumas
D'Artagnan
Gerard Derpadieu



Como decidiram pontuar?





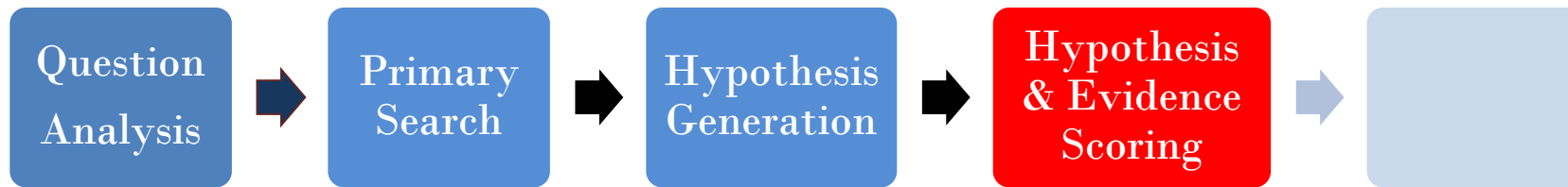
Dimensões ou Perspectivas

Respostas Candidatas	Lex	Geo	Temp	Taxon.
DiCaprio	0,7	0,0	0,0	0,7
Aramis	0,5	0,7	0,8	0,9
Alexandre Dumas	0,5	0,7	0,8	0,9
D'Artagnan	0,8	0,7	0,8	0,9
Gerard Derpadieu	0,5	0,6	0,0	0,7
.....	----	----	----	----
.....	----	----	----	----

.....

0,9

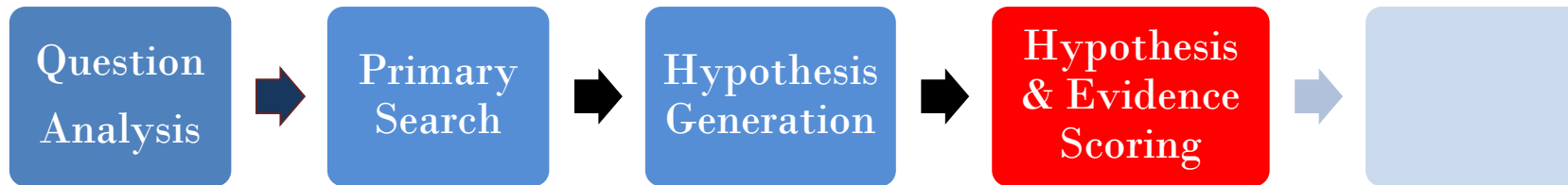
Grau de confiança
que aquela resposta
atende ao desafio,
naquela dimensão



Sobreposição Léxica

Respostas Candidatas	Lex
DiCaprio	0,7
Aramis	0,5
Alexandre Dumas	0,5
D'Artagnan	0,8
Gerard Derpadieu	0,5
.....	----
.....	----





Compatibilidade Temporal

Respostas Candidatas	Temp
DiCaprio	0,0
Aramis	0,8
Alexandre Dumas	0,8
D'Artagnan	0,8
Gerard Derpadieu	0,0
.....	----
.....	----

Desafio

Em maio de 1898, Portugal celebrou os 400 anos da chegada deste explorador na Índia.

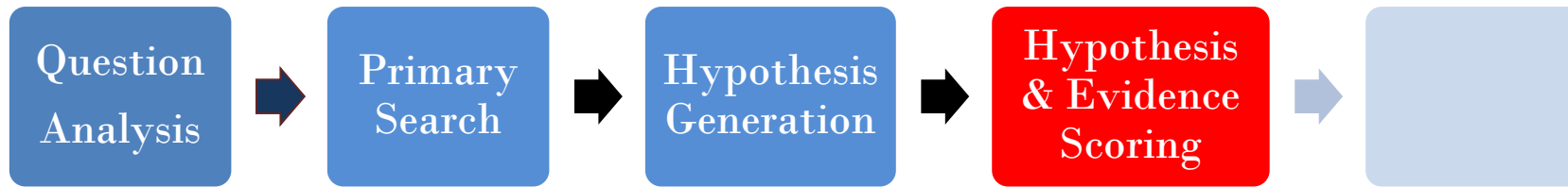
Proximidade Temporal

Resposta Candidata

Vasco da Gama

Evidência

Em 27 de maio de 1498, Vasco da Gama desembarcou na Praia de Kappad



Desafio

Em maio de 1898, Portugal celebrou os 400 anos da chegada deste explorador na Índia.

Proximidade Temporal

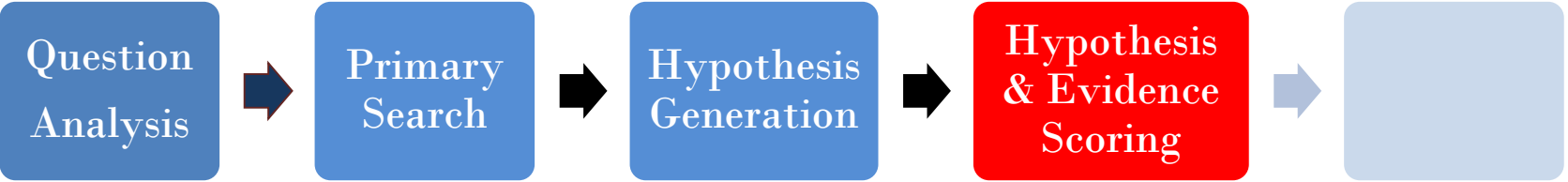
Fator de Confiança elevado nesta dimensão

Resposta Candidata

Vasco da Gama

Evidência

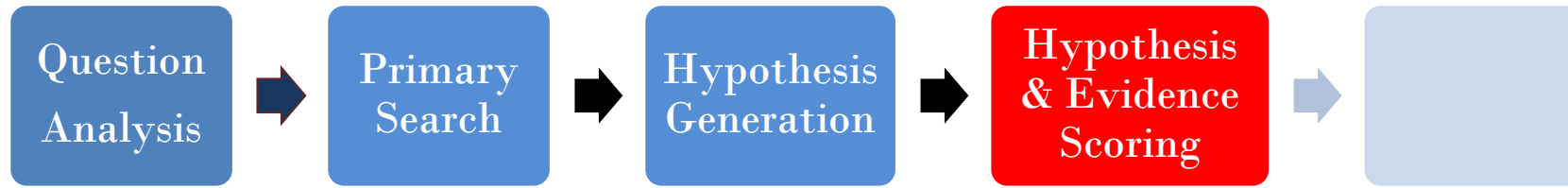
Em 27 de maio de 1498, Vasco da Gama desembarcou na Praia de Kappad



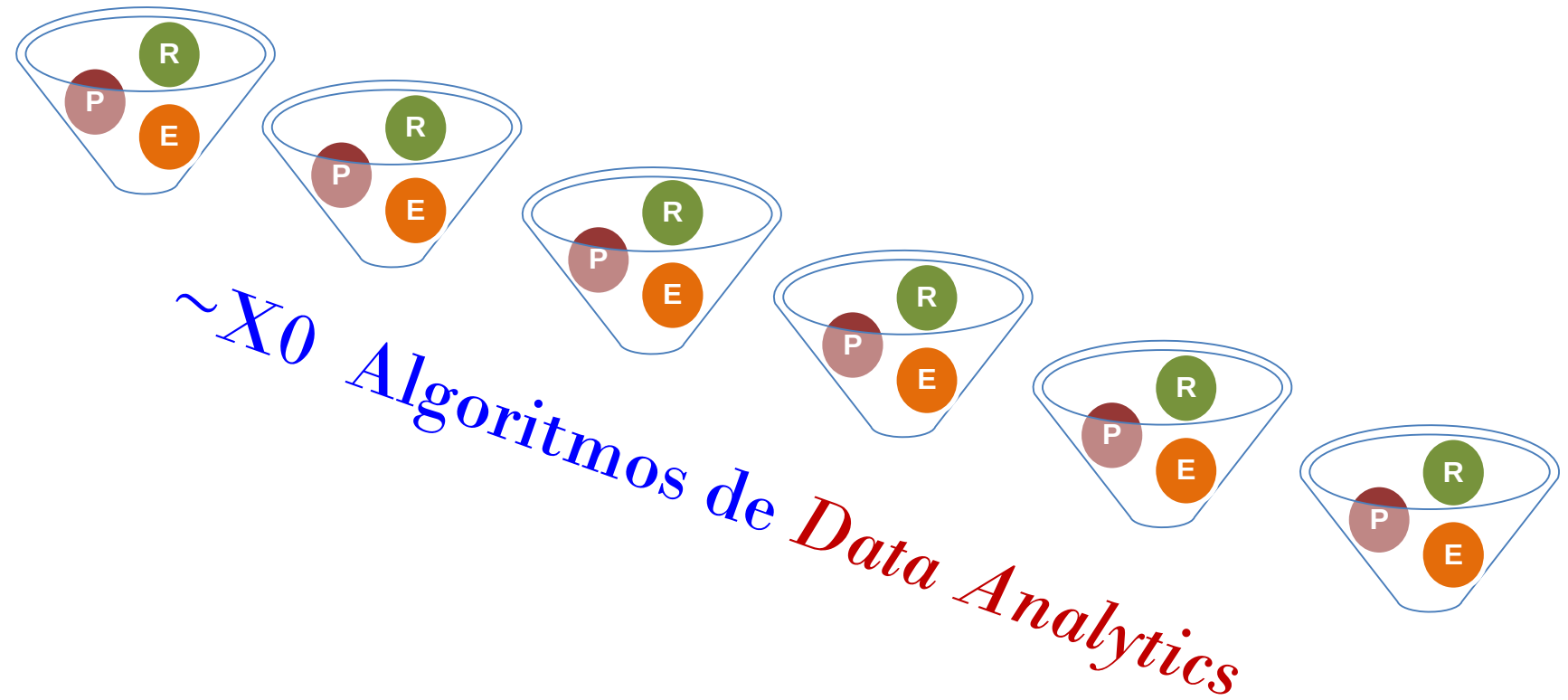
Dimensões ou Perspectivas

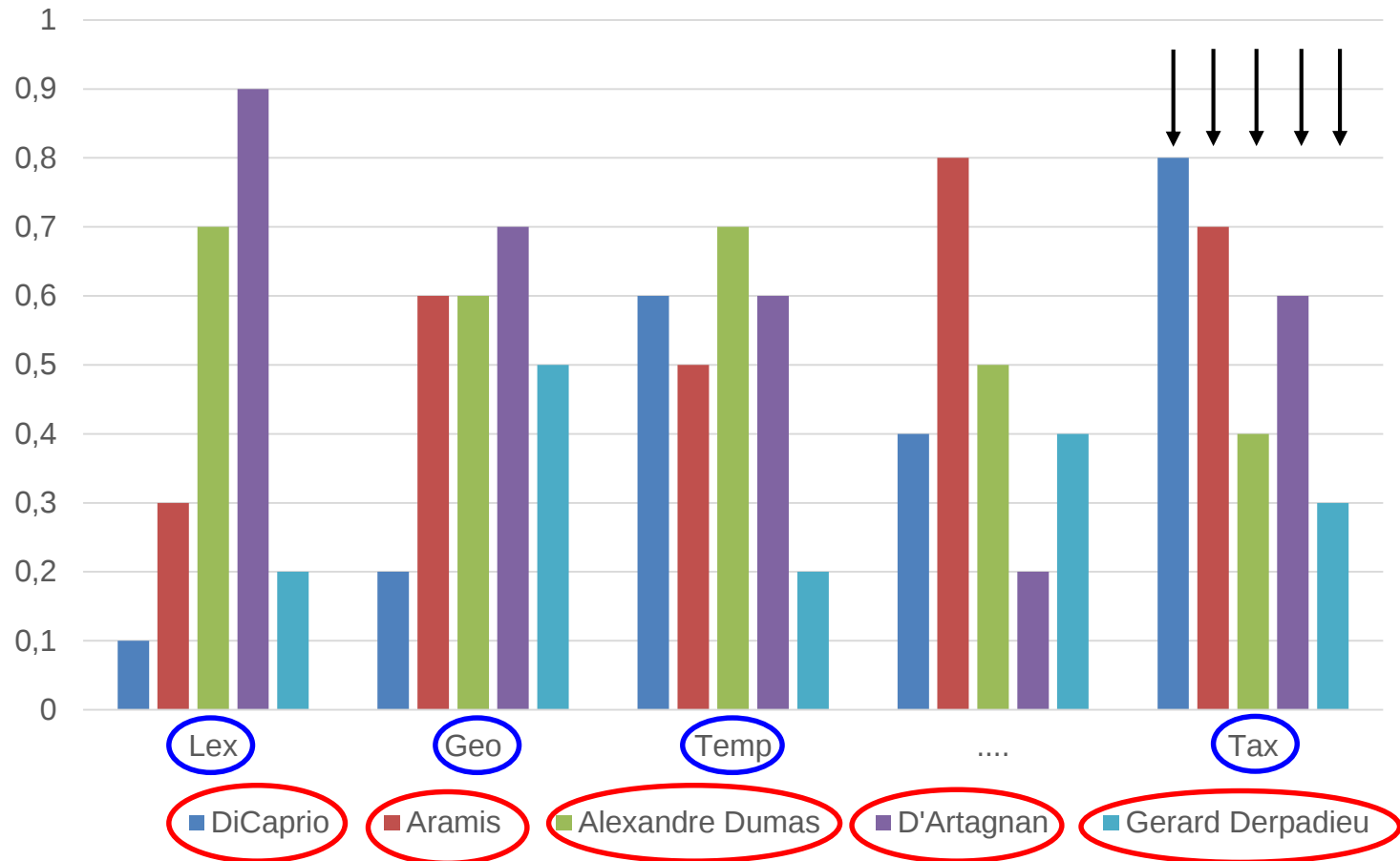
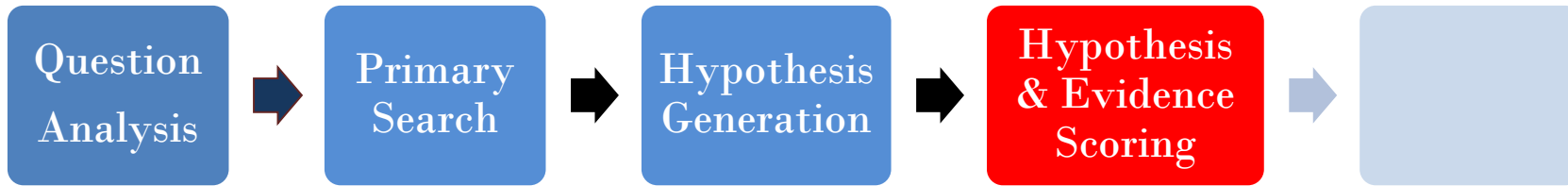
Cálculo
dos
Fatores
de
Confiança

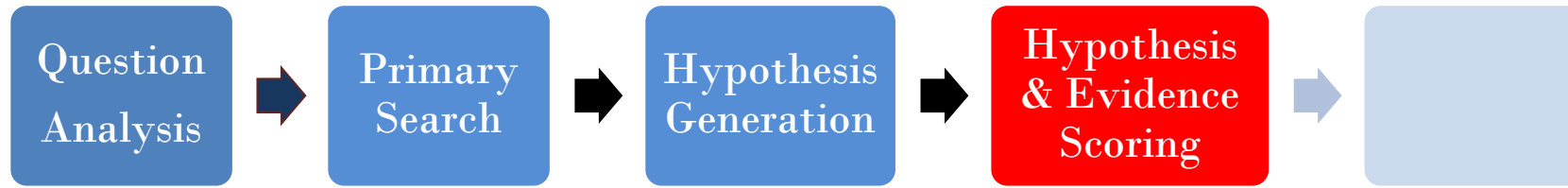
Respostas Candidatas	Lex	Geo	Temp			Taxon.
DiCaprio	0,7	0,0	0,0			0,7
Aramis	0,5	0,7	0,8			0,9
Alexandre Dumas	0,5	0,7	0,8			0,9
D'Artagnan	0,8	0,7	0,8			0,9
Gerard Derpadieu	0,5	0,6	0,0			0,7
.....	----	----	----			----
.....	----	----	----			----



Cálculo
dos
Fatores
de
Confiança

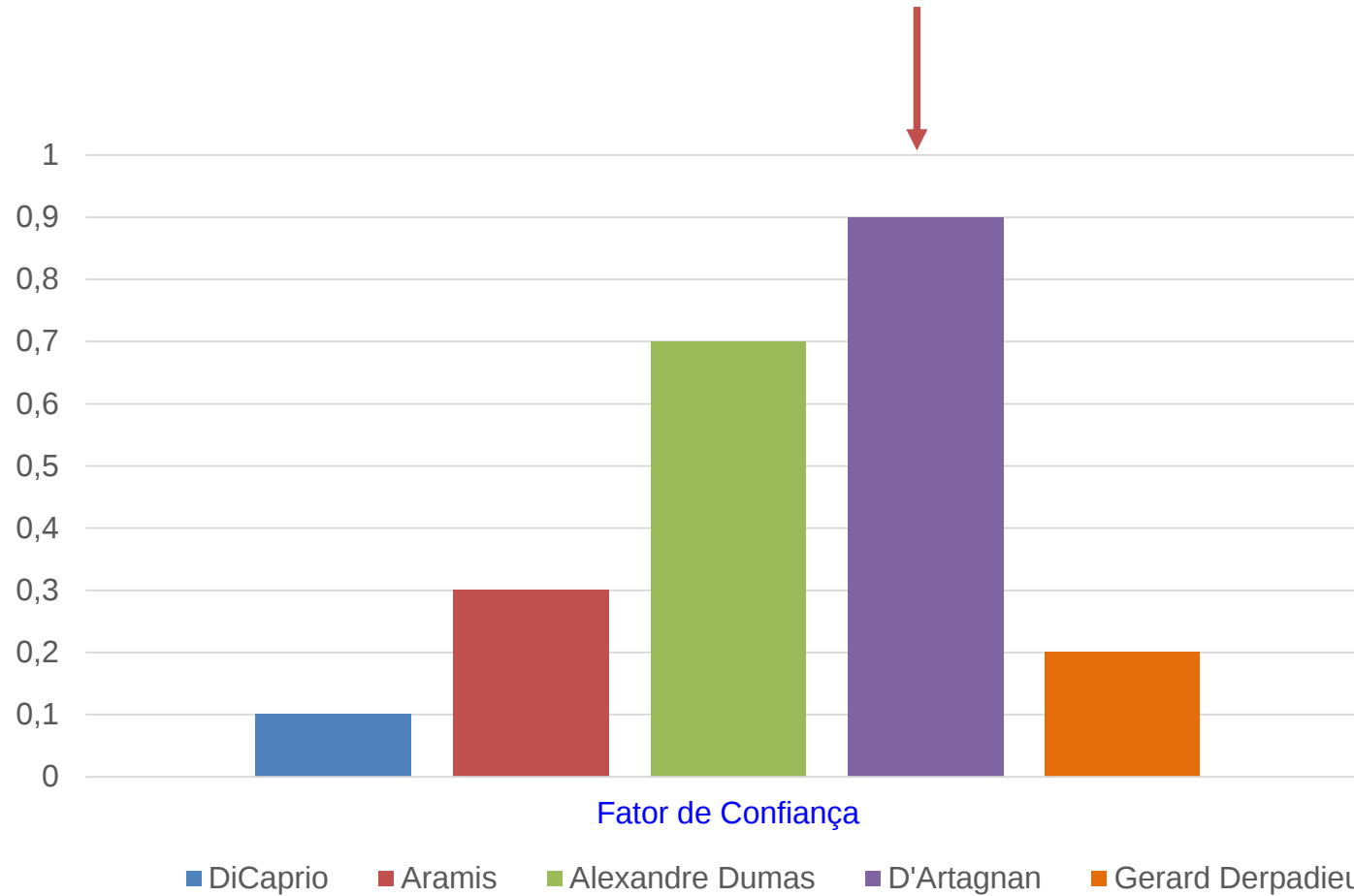
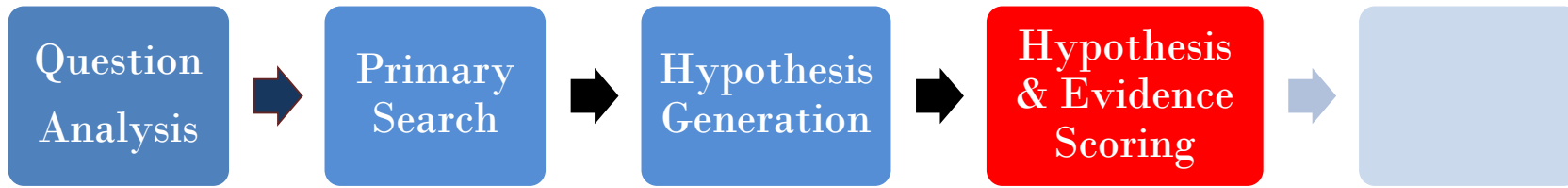


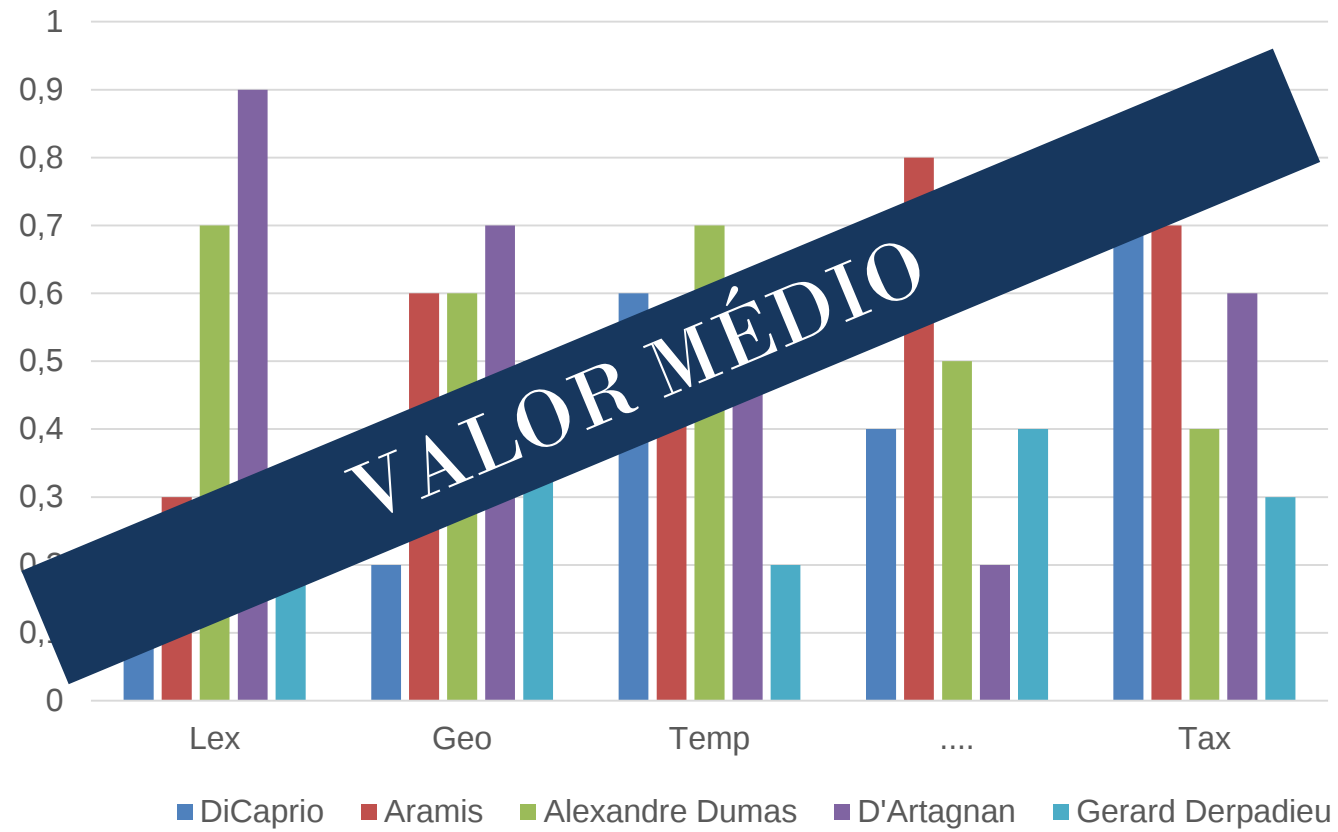
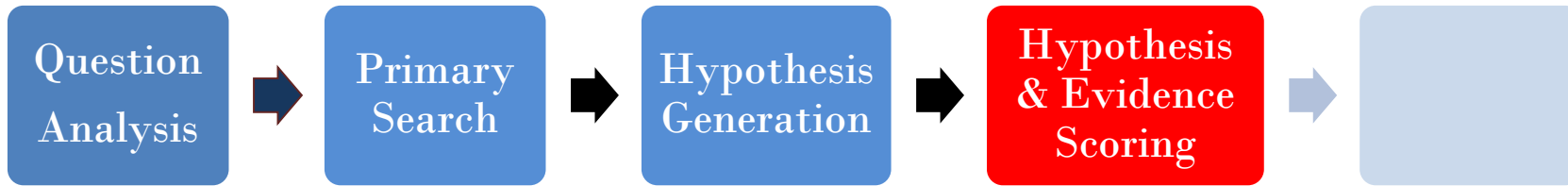


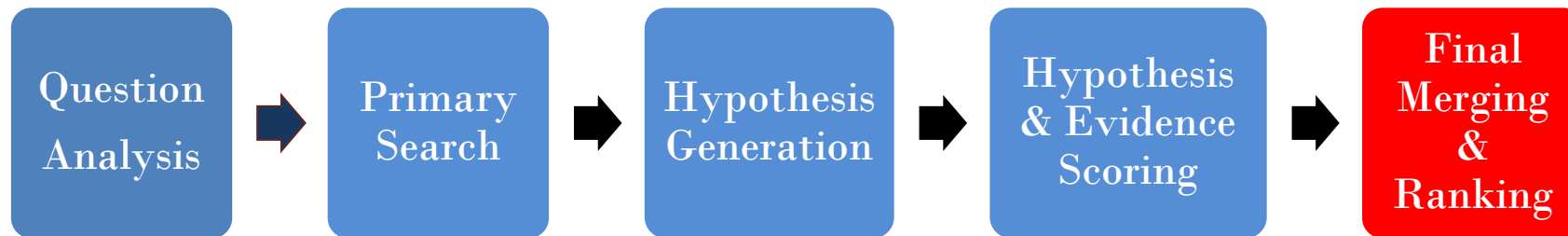


O que o Watson precisa para decidir?

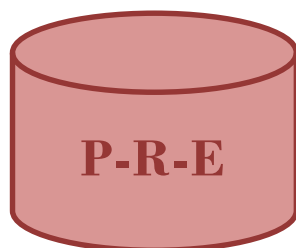
Saber qual é a melhor resposta candidata







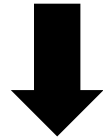
40 Anos
Jeopardy!



Resposta Candidata	Fator Confiança
D'Artagnan	78%
Aramis	60%
Alexandre Dumas	45%
Athos	6%
DiCaprio	0%
Derpadieu	0%
.....	----

Regressão Logística

Buzz Threshold



Limiar para acionamento da campanha

D'Artagnan

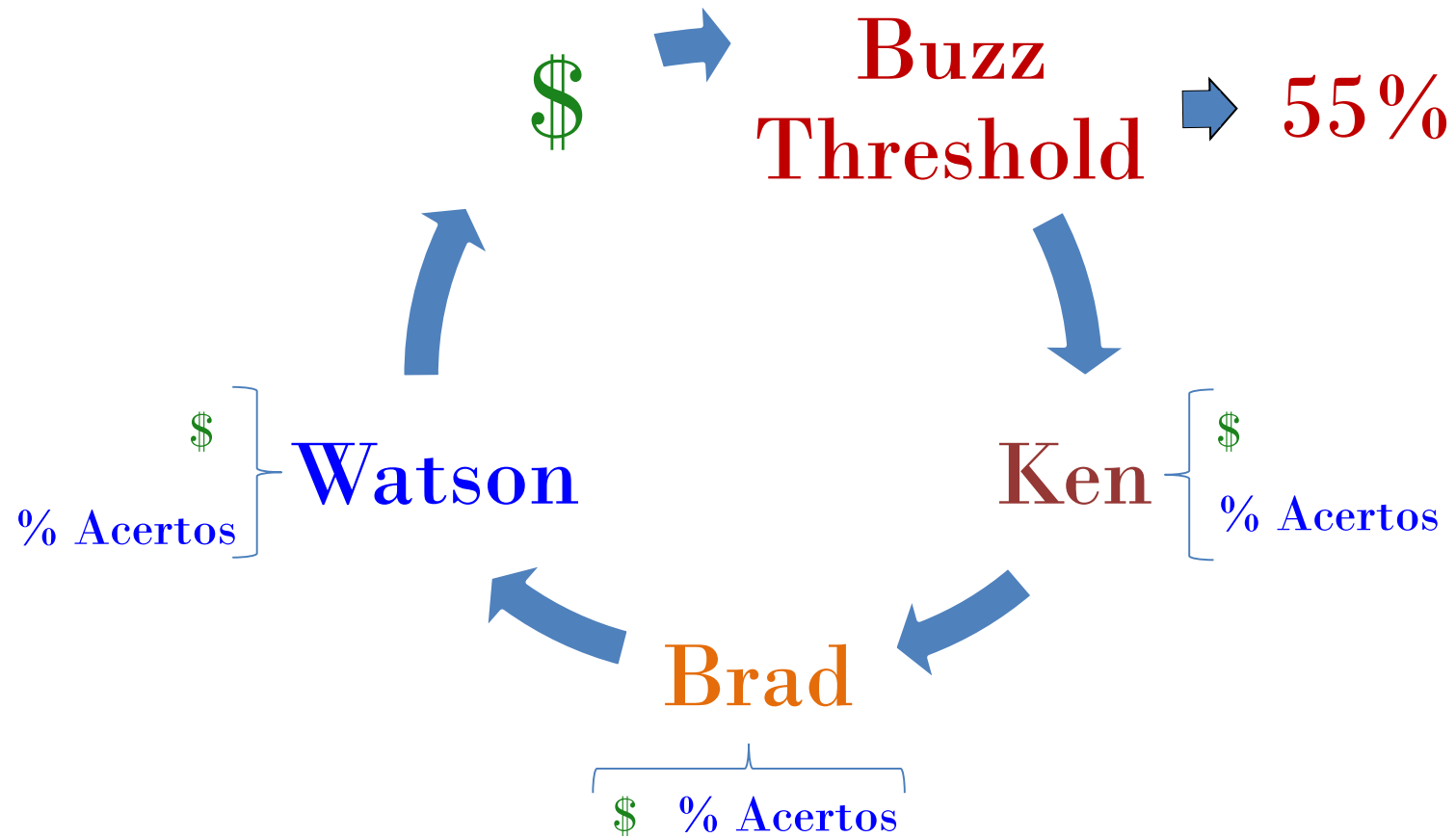


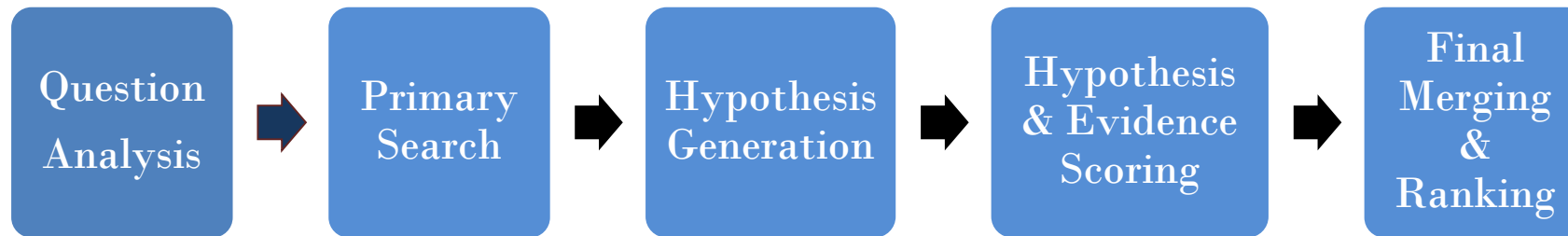
78%

$>$ Buzz Threshold

Quem é D'Artagnan?

Buzz Threshold Dinâmico

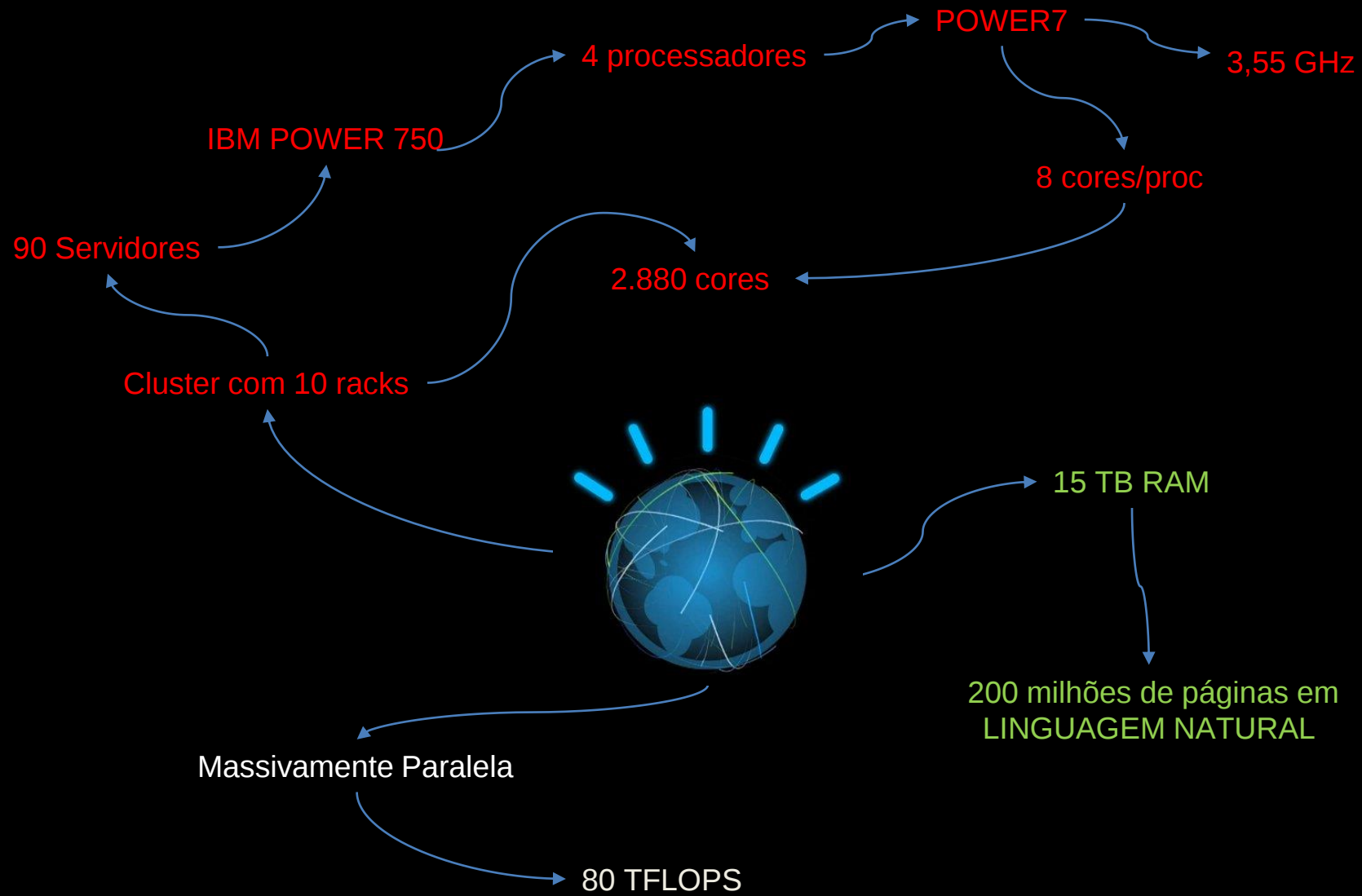




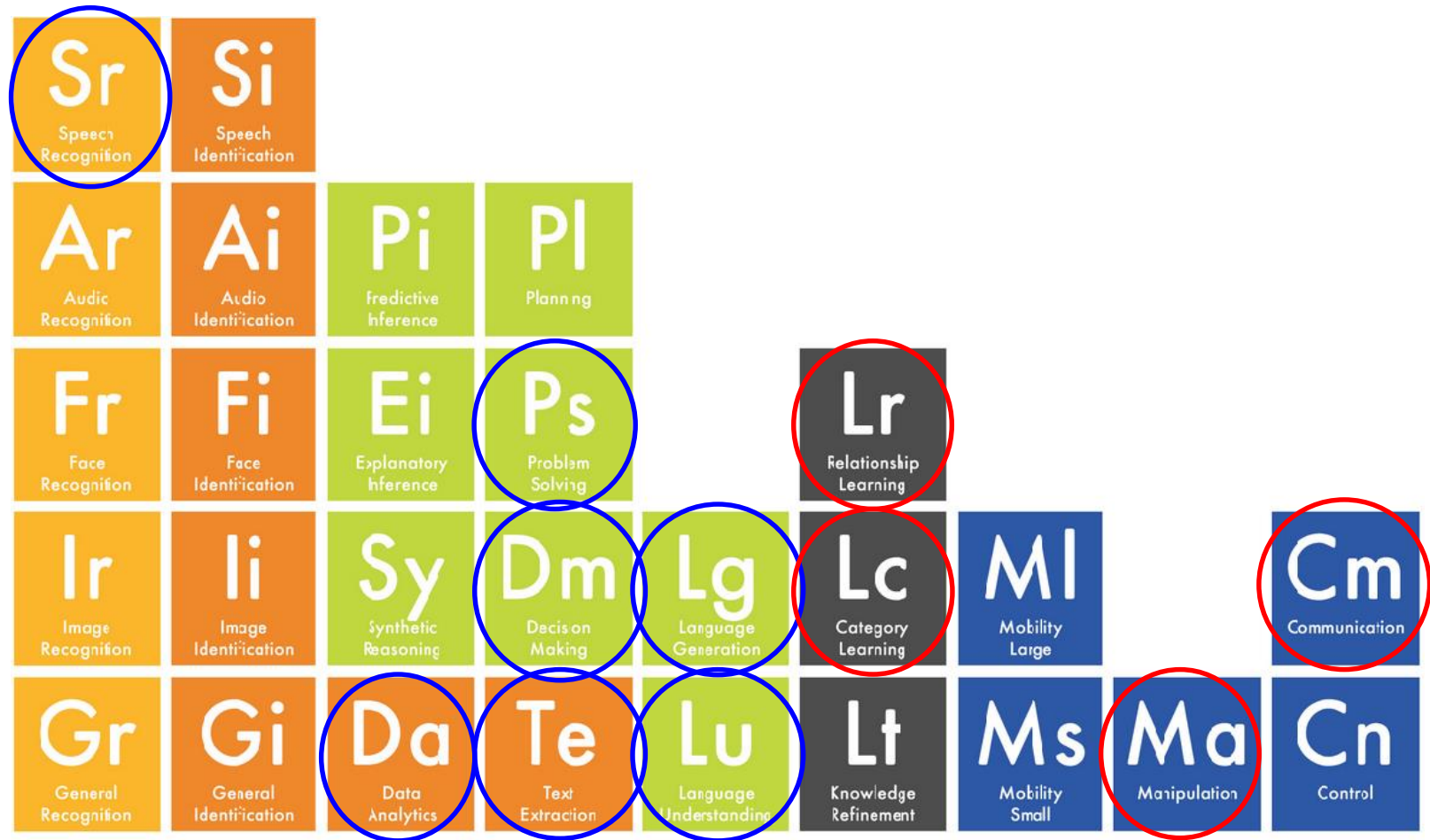
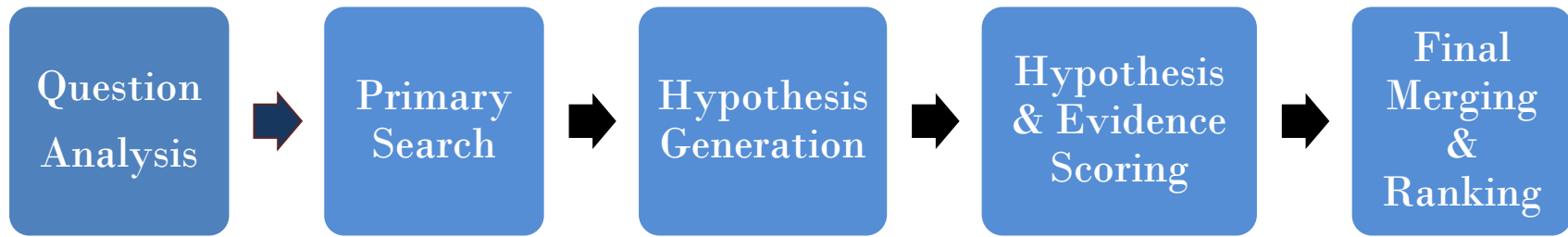
< 3"

Avatar do Watson

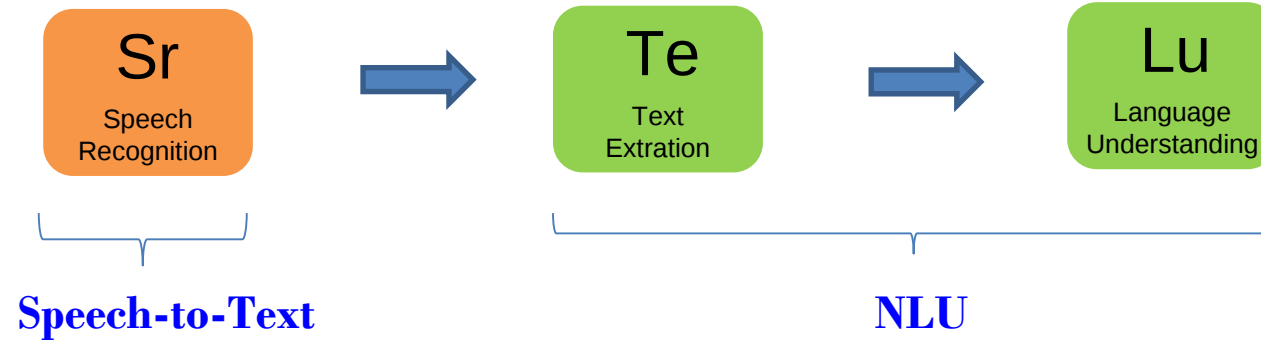


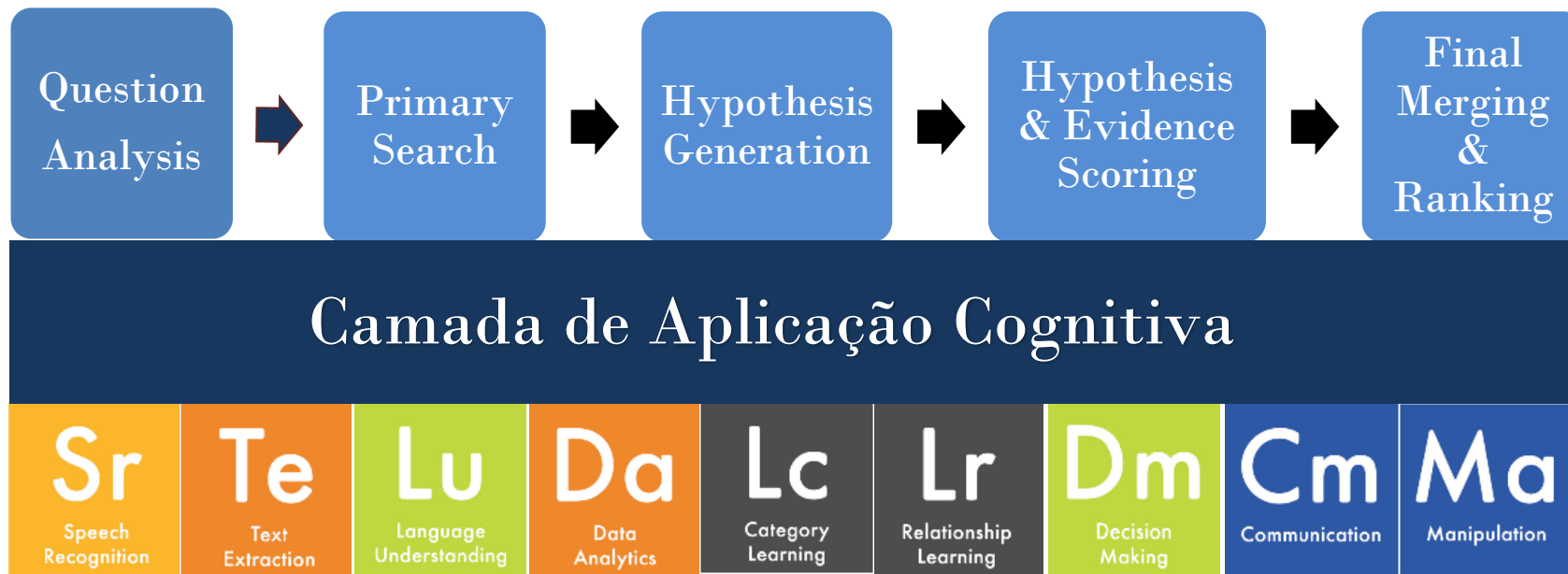


Por que este exemplo em detalhes?



A primeira pessoa mencionada pelo nome em "O Homem da Máscara de Ferro" é o herói de um livro anterior do mesmo autor.





prodemge



Camada de Aplicação Cognitiva



ou / e





OBRIGADO!!