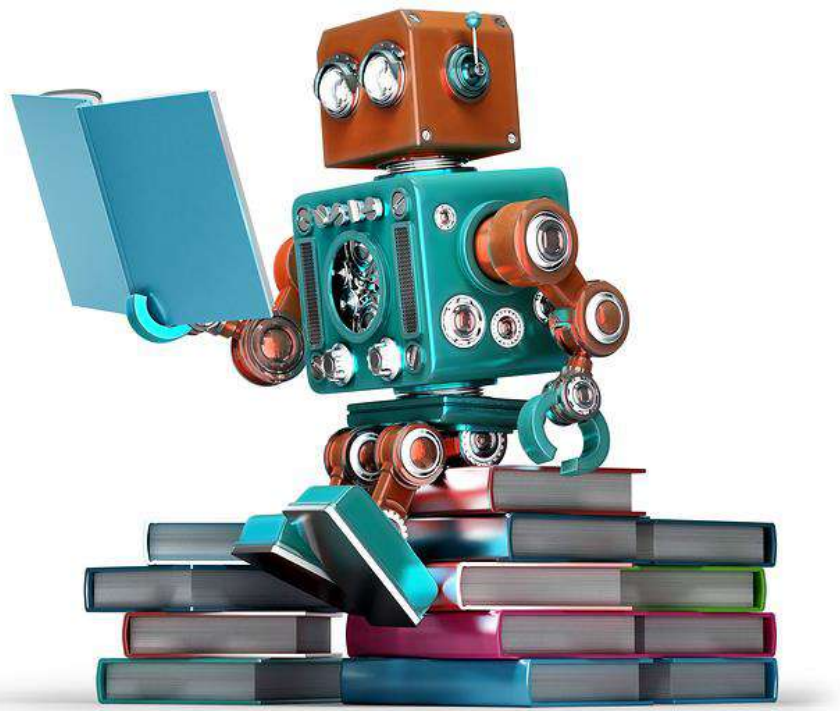
REASONING SYSTEMS

DAY 5



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DAY 5 AGENDA

5.1 Hybrid Reasoning Systems

5.2 Contemporary Reasoning Systems

5.3 Course **Assessment** 2

5.4 Create Hybrid Reasoning System **Workshop**

DAY 5 TIMETABLE

No	Time	Topic	By Whom	Where
1	9 am	5.1 Hybrid Reasoning Systems	GU Zhan (Sam)	Class
2	10.10 am	Morning Break		
3	10.30 am	5.2 Contemporary Reasoning Systems	GU Zhan (Sam)	Class
4	10:45 am	5.3 Course Assessment	All	Class
5	12.10 pm	Lunch Break		
6	1.30 pm	5.4 Create Hybrid Reasoning System Workshop 1	All	Class
7	3.10 pm	Afternoon Break		
8	3.30 pm	5.4 Create Hybrid Reasoning System Workshop 2	All	Class
9	4.50 pm	Summary and Review	All	Class
10	5 pm	End		

5.1
HYBRID REASONING SYSTEMS

5.1 HYBRID REASONING SYSTEMS

Hybrid Intelligent systems are intelligent systems which combine two or more machine reasoning techniques:

- **Deductive Reasoning used in Analytic Problem Solving**
  - Learnt : Knowledge-driven Rule/Process Systems; Fuzzy Logic
  - To learn : Cognitive Systems; Belief Desire Intention (BDI) framework
- **Inductive Reasoning used in Data Mining & Machine Learning**
  - Learnt : Decision Tree; Association Rule
  - To learn : Neural Networks; Bayesian Net; Reinforcement Learning
- **Planning & Optimization used in Synthetic Problem Solving**
  - Learnt : Search; Genetic Algorithms
  - To learn : Swarm Intelligence; Multi-Agent Systems

☺ Another common term for hybrid intelligent systems is "Hybrid Soft Computing Systems".

5.1 HYBRID REASONING SYSTEMS

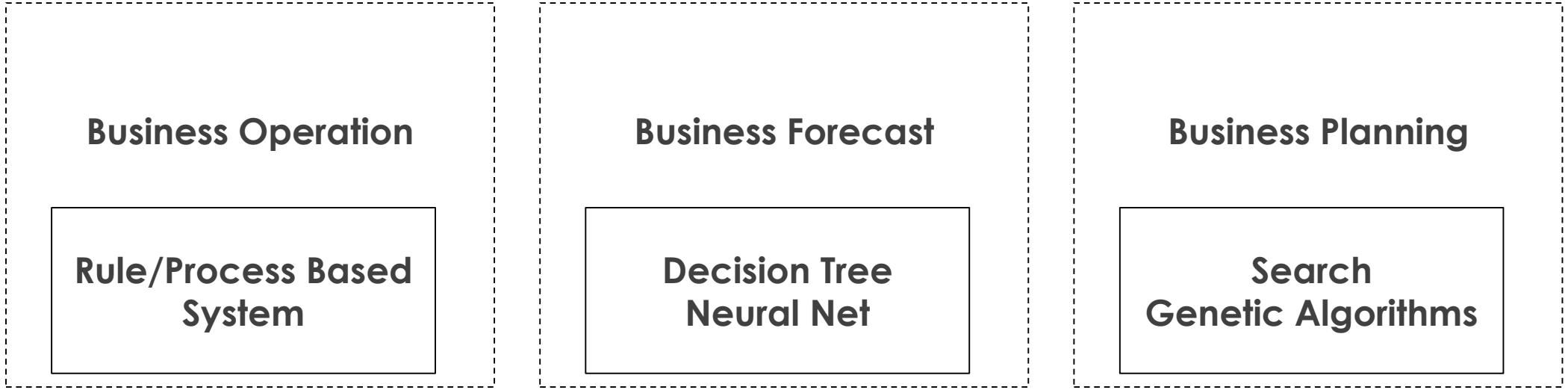
Four broad types of system architectures

1. Independent Sub-systems
2. Competing Experts
3. Self-Tuning
4. Cooperating Experts

5.1 HYBRID REASONING SYSTEMS

1. Independent Sub-systems

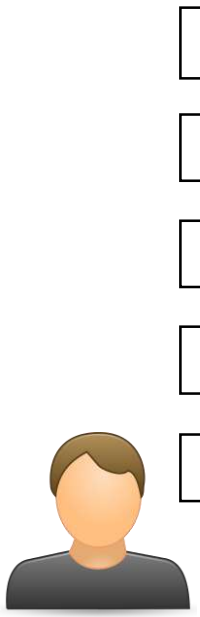
- Sub-divide problem into independent parts.
- Each is solved by an appropriate technique or sub-system.
- No cooperation is required, e.g. a decision support system has several independent sub-systems (functions).



5.1 HYBRID REASONING SYSTEMS

2. Competing Experts

- Different solution strategies (experts) offer alternative solutions.
- Another process decides which solution to accept or how to combine the solutions, e.g. majority vote algorithm or a rule-based system. (auction, tender, bidding)



Rule Based System

Decision Tree

Genetic Algorithm

Search System

Individual Experts

Arbitrator System

Solution / Decision / Forecasting

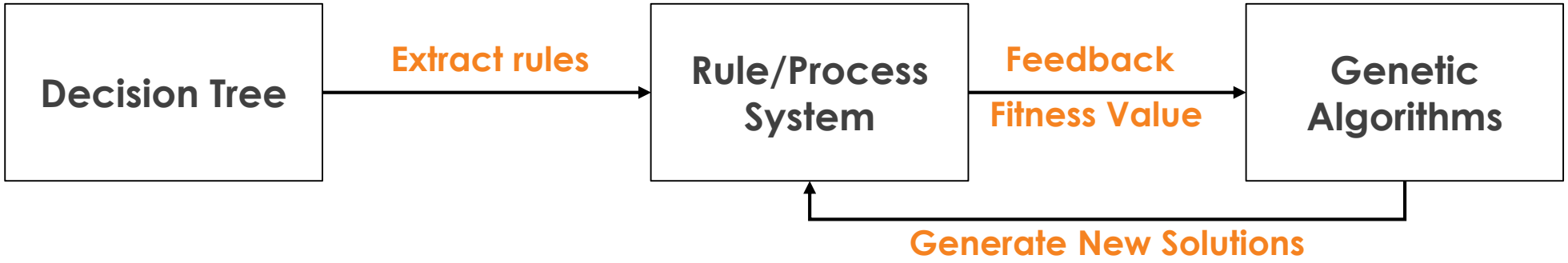
Simple Committee:
If majority of experts agree then good decision, else unreliable decision.

Ensemble Arbitrator:
Weight expert judgments according to circumstances.

5.1 HYBRID REASONING SYSTEMS

3. Self-Tuning

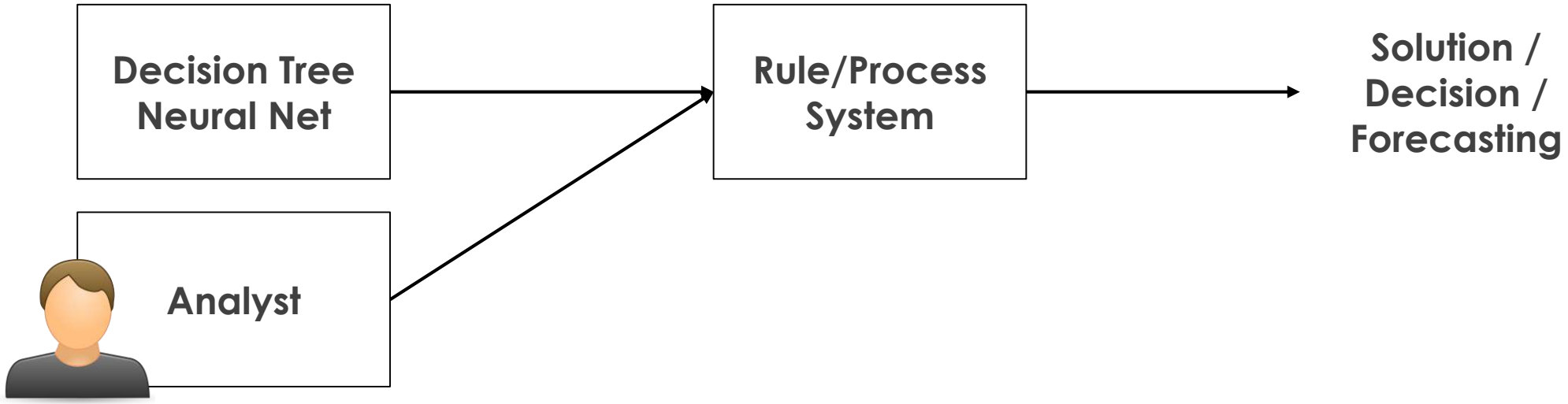
- One technique is used to tune or learn the architecture for another, e.g. Decision Tree used to learn a ruleset, e.g. trading strategies; Genetic Algorithms used to optimise initial solution, e.g. investment portfolio, based on predicted/simulated value from rule based system, in order to maximize trading profit.



5.1 HYBRID REASONING SYSTEMS

4. Co-operating Experts

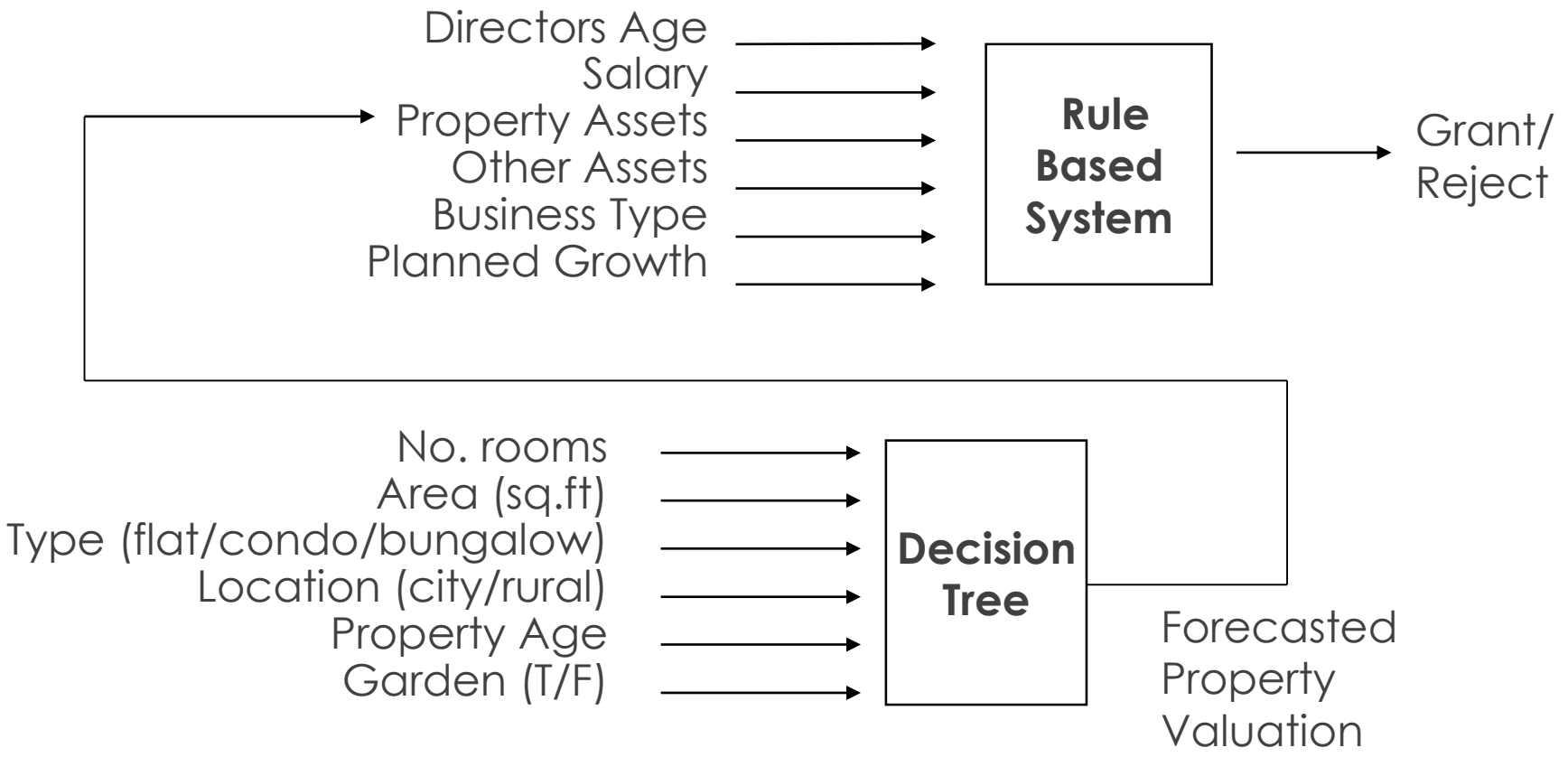
- **Pooled Expertise: Different techniques/sub-systems work together as a team to produce a single solution. No single technique/expert is sufficient alone, e.g. Machine learning and human analyst both provide inputs required to forecast macroeconomics based on business rules and weights, under different market conditions.**



5.1 HYBRID REASONING SYSTEMS

4. Co-operating Experts

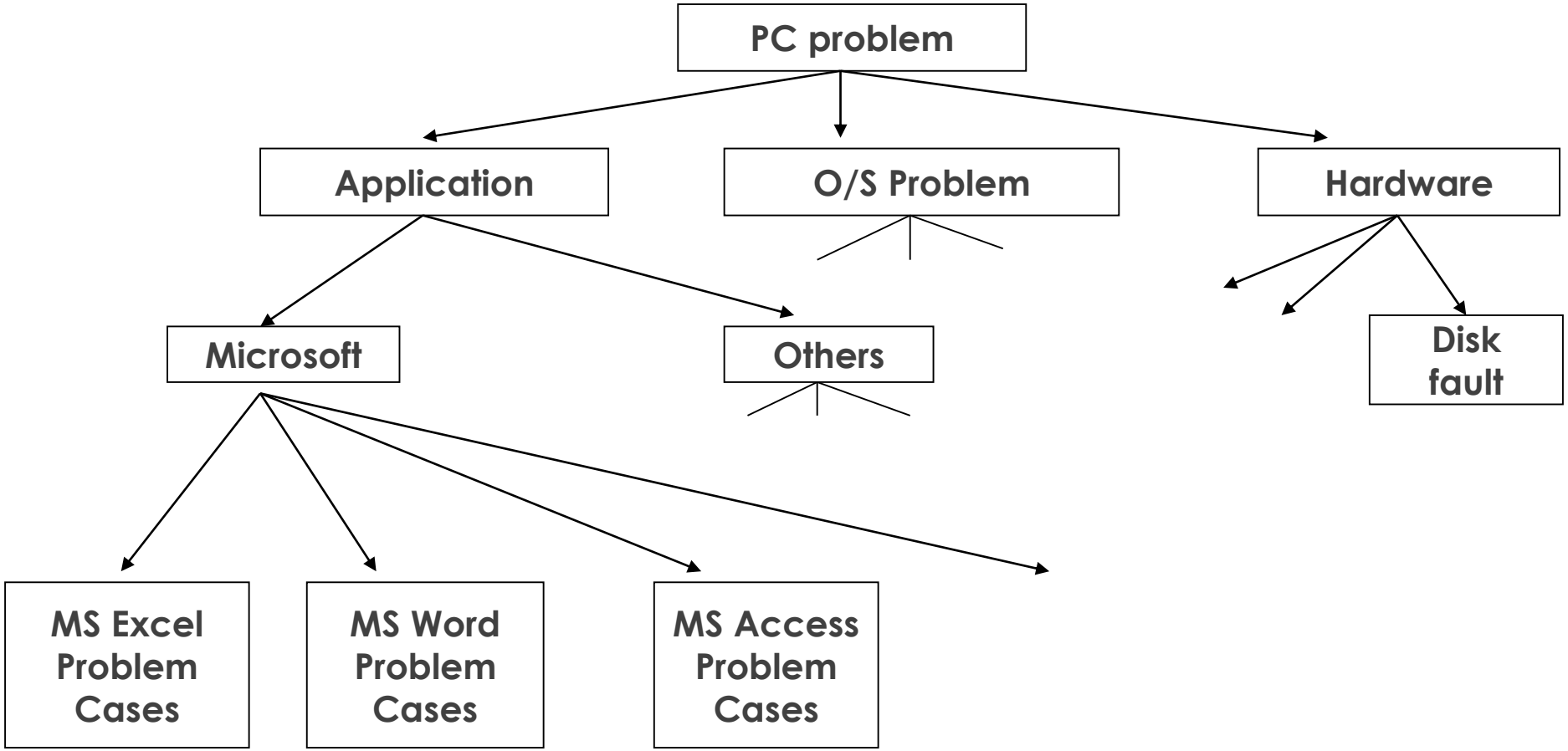
- **Use case: Approving business loan to a small company**



5.1 HYBRID REASONING SYSTEMS

4. Co-operating Experts

- Use case: IT helpdesk diagnostic system (decision tree + case based reasoning)

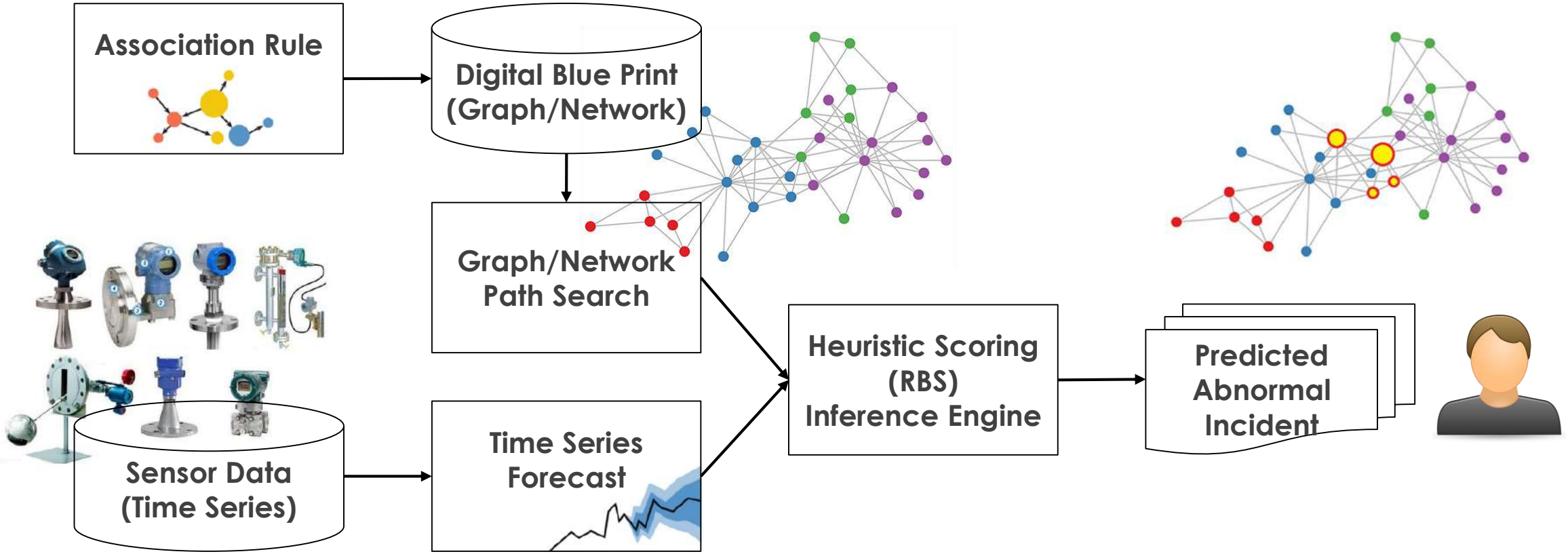


5.1 HYBRID REASONING SYSTEMS

4. Co-operating Experts

- **Use case: Plant Abnormal Situation Prediction (Predictive Maintenance)**

  Sub-systems: Time Series Forecast, Association Rule, Graph Search, Heuristic Score

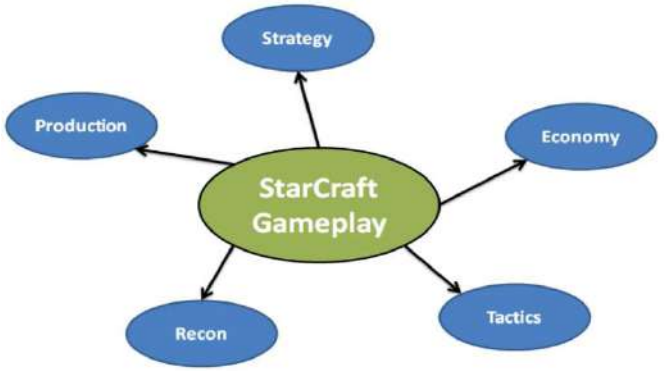


https://4.imimg.com/data4/QI/WE/MY-24712837/different-types-of-level-transmitters-500x500.jpg
http://tkipf.github.io/graph-convolutional-networks/images/karate.png
https://www.microsoft.com

5.1 HYBRID REASONING SYSTEMS

4. Co-operating Experts

- Finite state machines
- Scripting
- Dynamic scripting
- Probabilistic inference
- Influence maps
- Neural networks
- Swarm intelligence
- Potential fields
- Genetic programming



Bot vs. Bot Results - (Row,Col) = Row Wins vs. Col

	Win %	IceBo	Ximp	LetaB	Alur	Skyne	Xelna	UAlbe	MaasC	Moose	BTHAI	Terra	NUSBo	Nova	HITA	CruzB	Bonjw	Orita	Yarmo
IceBot	85.86	-	61/67	42/67	30/67	39/67	28/67	62/67	64/67	65/67	67/67	67/67	67/67	55/67	63/67	67/67	67/67	67/67	67/67
Ximp	84.64	6/67	-	30/67	51/67	62/67	49/67	64/67	50/67	67/67	67/67	66/67	62/67	56/67	67/67	67/67	67/67	66/67	67/67
LetaBot	82.09	25/67	37/67	-	65/67	67/67	51/67	46/67	15/67	65/67	60/67	62/67	63/67	58/67	59/67	67/67	63/67	67/67	65/67
Alur	70.94	37/67	16/67	2/67	-	56/67	45/67	49/67	41/67	46/67	64/67	59/67	38/67	57/67	50/67	55/67	67/67	63/67	63/67
Skynet	68.74	28/67	5/67	0/67	11/67	-	44/67	31/67	63/67	66/67	67/67	67/67	15/67	51/67	67/67	67/67	67/67	67/67	67/67
Xelnaga	68.31	39/67	18/67	16/67	22/67	23/67	-	13/67	56/67	31/67	49/67	66/67	67/67	56/67	62/67	66/67	66/67	61/67	67/67
UAlbertaBot	67.25	5/67	3/67	21/67	18/67	36/67	54/67	-	63/67	36/67	30/67	40/67	67/67	62/67	65/67	65/67	67/67	67/67	67/67
MaasCraft	59	3/67	17/67	52/67	26/67	4/67	11/67	4/67	-	32/67	33/67	55/67	60/67	52/67	67/67	62/67	67/67	60/67	67/67
MooseBot	50.13	2/67	0/67	2/67	21/67	1/67	36/67	31/67	35/67	-	15/67	27/67	65/67	35/67	66/67	50/67	53/67	65/67	67/67
BTHAI	46.8	0/67	0/67	7/67	3/67	0/67	18/67	37/67	34/67	52/67	-	33/67	38/67	47/67	65/67	34/67	35/67	64/67	66/67
TerranUAB	42.93	0/67	1/67	5/67	8/67	0/67	1/67	27/67	12/67	40/67	34/67	-	33/67	46/67	45/67	60/67	55/67	61/67	61/67
NUSBot	37.23	0/67	5/67	4/67	29/67	52/67	0/67	0/67	7/67	2/67	29/67	34/67	-	35/67	31/67	16/67	60/67	60/67	60/67
Nova	32.4	12/67	11/67	9/67	10/67	16/67	11/67	5/67	15/67	32/67	20/67	21/67	32/67	-	17/67	41/67	44/67	38/67	35/67
HITA	32.13	4/67	0/67	8/67	17/67	0/67	5/67	2/67	0/67	1/67	2/67	22/67	36/67	50/67	-	39/67	49/67	65/67	66/67
CruzBot	29.15	0/67	0/67	0/67	12/67	0/67	1/67	2/67	5/67	17/67	33/67	7/67	51/67	26/67	28/67	-	61/67	32/67	57/67
Bonjwa	16.51	0/67	0/67	4/67	0/67	0/67	1/67	0/67	0/67	14/67	32/67	12/67	7/67	23/67	18/67	6/67	-	43/67	28/67
Oritaka	14.4	0/67	1/67	0/67	4/67	0/67	6/67	0/67	7/67	2/67	3/67	6/67	7/67	29/67	2/67	35/67	24/67	-	38/67
Yarmouk	11.5	0/67	0/67	2/67	4/67	0/67	0/67	0/67	0/67	0/67	1/67	6/67	7/67	32/67	1/67	10/67	39/67	29/67	-

5.1 HYBRID REASONING SYSTEMS

Bot	Games	Win	Loss	Win %	AvgTime	Game Time Limit	Crash	Frame Timeout
SAIDA	2590	2484	106	95.91	15:36	27	0	8
CherryPi	2592	2355	237	90.86	12:21	19	0	0
CSE	2591	2257	334	87.11	11:59	5	1	0
BlueBlueSky	2586	2107	479	81.48	12:13	18	1	0
Locutus	2586	2095	491	81.01	12:14	29	1	0
ISAMind	2586	2029	557	78.46	12:07	13	1	0
DaQin	2590	1875	715	72.39	12:45	11	1	2
McRave	2592	1704	888	65.74	12:36	7	83	120
Iron	2582	1647	935	63.79	13:23	32	50	42
ZZZKBot	2576	1317	1259	51.13	8:35	3	1	0
Steamhammer	2583	1317	1266	50.99	11:48	8	0	22
Microwave	2582	1303	1279	50.46	12:09	11	17	7
LastOrder	2598	1279	1319	49.23	16:01	30	10	0
Tyr	2592	1156	1436	44.6	13:14	11	3	0
MetaBot	2393	1063	1330	44.42	14:32	38	80	80
LetaBot	2553	965	1588	37.8	15:45	78	29	12
Arrakhammer	2586	963	1623	37.24	12:21	8	11	10
Ecgberht	2579	947	1632	36.72	13:55	45	4	0
UAlbertaBot	2587	898	1689	34.71	11:32	50	46	0
Ximp	2579	841	1738	32.61	17:09	39	197	249
CDBot	2583	826	1757	31.98	10:29	8	130	6
Aiur	2570	811	1759	31.56	13:34	64	37	0
KillAll	2591	768	1823	29.64	11:01	12	3	15
WillyT	2586	718	1868	27.76	12:53	7	121	0
AILien	2584	698	1886	27.01	13:11	2	485	121
CUNYBot	2399	236	2163	9.84	11:04	10	320	44
Hellbot	2572	35	2537	1.36	9:01	21	5	0
Total	34694	34694	34694	N/A	12:43	303	1637	738

Link
https://www.youtube.com/watch?v=fai1cRra_Go

Link
https://www.cs.mun.ca/~dchurchill/starcraftaicomp/2018/

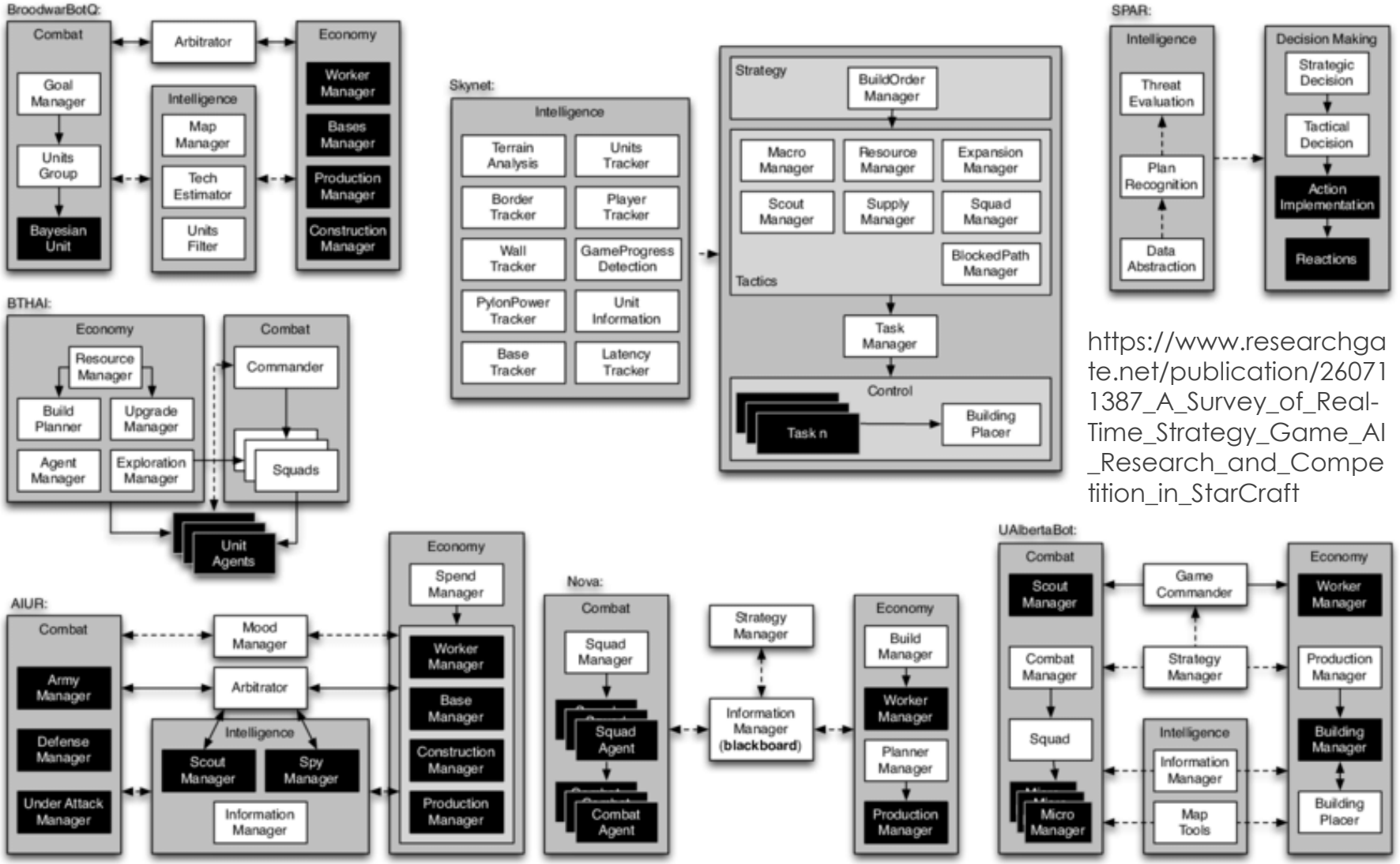
Link
https://github.com/TeamSAIDA/SAIDA

Bot	Win %	SAID	Cher	CSE	Blue	Locu	ISAM	DaQi	McRa	Iron	ZZZK	Stea	Micr	Last	Tyr	Meta	Leta	Arra	Ecgb	UAlb	Ximp	CDBo	Aiur	Kill	Will	AILi	CUNY	Hell
SAIDA	95.91	-	063/100	093/100	097/100	096/100	089/100	095/100	096/100	098/100	097/100	097/100	100/100	100/100	100/100	90/94	098/100	100/100	100/100	087/100	098/100	096/100	095/100	096/100	099/100	100/100	94/96	100/100
CherryPi	90.86	037/100	-	072/100	086/100	089/100	095/100	100/100	095/100	096/100	091/100	80/99	091/100	082/100	096/100	92/93	098/100	089/100	099/100	098/100	098/100	100/100	096/100	100/100	100/100	100/100	100/100	100/100
CSE	87.11	007/100	028/100	-	066/100	068/100	078/100	084/100	71/99	098/100	091/100	098/100	099/100	100/100	100/100	89/95	091/100	100/100	100/100	048/100	100/100	099/100	096/100	100/100	100/100	99/99	97/98	100/100
BlueBlueSky	81.48	003/100	003/100	034/100	-	061/100	066/100	092/100	072/100	098/100	088/100	097/100	094/100	100/100	100/100	60/94	095/100	092/100	100/100	089/100	095/100	096/100	072/100	097/100	100/100	100/100	92/92	100/100
Locutus	81.01	004/100	011/100	032/100	039/100	-	056/100	076/100	054/100	088/100	095/100	097/100	096/100	100/100	097/100	90/96	094/100	097/100	100/100	094/100	094/100	100/100	095/100	098/100	100/100	098/100	90/90	100/100
ISAMind	78.46	013/100	004/100	022/100	034/100	044/100	-	063/100	049/100	098/100	089/100	096/100	093/100	100/100	095/100	79/90	092/100	098/100	100/100	095/100	093/100	099/100	082/100	092/100	100/100	100/100	96/96	100/100
DaQin	72.39	005/100	060/100	016/100	000/100	024/100	037/100	-	042/100	092/100	087/100	098/100	95/99	096/100	099/100	58/95	095/100	099/100	100/100	086/100	073/100	097/100	081/100	096/100	100/100	097/100	89/96	100/100
McRave	65.74	014/100	010/100	28/99	028/100	046/100	051/100	058/100	-	055/100	072/100	063/100	079/100	096/100	088/100	49/97	074/100	098/100	096/100	71/99	041/100	100/100	077/100	058/100	074/100	083/100	89/97	100/100
Iron	63.79	002/100	004/100	002/100	002/100	013/100	002/100	008/100	045/100	-	041/100	073/100	086/100	093/100	094/100	86/86	066/100	094/100	100/100	091/100	090/100	088/100	097/100	085/100	100/100	093/100	87/96	100/100
ZZZKBot	51.13	003/100	009/100	009/100	012/100	005/100	011/100	013/100	028/100	059/100	-	059/100	057/100	055/100	035/100	68/85	040/100	083/100	075/100	086/100	100/100	072/100	089/100	058/100	092/100	073/100	77/91	099/100
Steamhammer	50.99	10/99	002/100	003/100	003/100	004/100	001/100	037/100	027/100	041/100	-	024/100	025/100	053/100	50/88	074/100	057/100	096/100	089/100	079/100	084/100	088/100	091/100	093/100	083/100	91/96	100/100
Microwave	50.46	000/100	009/100	001/100	006/100	004/100	007/100	04/99	021/100	014/100	043/100	076/100	-	057/100	052/100	66/92	080/100	068/100	073/100	081/100	065/100	078/100	081/100	091/100	086/100	50/99	90/92	100/100
LastOrder	49.23	000/100	010/100	000/100	000/100	000/100	000/100	004/100	004/100	009/100	045/100	075/100	043/100	-	057/100	87/99	075/100	083/100	004/100	095/100	085/100	089/100	095/100	089/100	035/100	092/100	95/99	100/100
Tyr	44.6	000/100	004/100	000/100	000/100	003/100	005/100	001/100	012/100	006/100	065/100	047/100	048/100	043/100	-	20/90	061/100	096/100	046/100	058/100	098/100	100/100	050/100	094/100	049/100	062/100	88/94	100/100
MetaBot	44.42	04/94	01/93	08/95	34/94	05/96	11/99	37/95	48/97	01/86	17/85	38/88	26/92	12/90	78/98	-	32/78	56/91	79/92	52/94	38/94	64/94	62/85	47/95	85/93	62/95	80/92	87/88
LetaBot	37.8	002/100	002/100	009/100	005/100	006/100	008/100	005/100	026/100	034/100	060/100	026/100	020/100	025/100	039/100	46/78	-	042/100	076/100	041/100	078/100	044/100	036/100	053/100	078/100	092/100	67/75	100/100
Arrakhammer	37.24	000/100	011/100	000/100	008/100	003/100	002/100	001/100	001/100	006/100	017/100	043/100	032/100	012/100	004/100	35/91	058/100	-	069/100	043/100	071/100	077/100	054/100	059/100	094/100	063/100	95/95	100/100
Ecgberht	36.72	000/100	001/100	000/100	000/100	000/100	000/100	000/100	004/100	000/100	075/100	004/100	027/100	006/100	054/100	21/92	024/100	031/100	-	058/100	079/100	038/100	057/100	066/100	058/100	084/100	83/87	095/100
UAlbertaBot	34.71	013/100	002/100	002/100	011/100	006/100	005/100	012/100	28/99	009/100	019/100	011/100	019/100	005/100	042/100	42/94	059/100	057/100	042/100	-	048/100	045/100	064/100	075/100	041/100	070/100	78/94	098/100
Ximp	32.61	002/100	001/100	000/100	005/100	006/100	007/100	027/100	059/100	001/100	000/100	031/100	035/100	018/100	002/100	56/94	022/100	029/100	021/100	052/100	-	003/100	068/100	084/100	096/100	064/100	71/85	094/100
CDBot	31.98	004/100	000/100	001/100	004/100	000/100	001/100	003/100	000/100	017/100	028/100	016/100	022/100	011/100	000/100	30/94	056/100	023/100	062/100	055/100	097/100	-	022/100	062/100	078/100	066/100	79/89	093/100
Aiur	31.56	005/100	001/100	004/100	028/100	005/100	11/100	012/100	027/100	003/100	011/100	012/100	010/100	005/100	050/100	23/85	064/100	046/100	043/100	036/100	032/100	077/100	-	027/100	061/100	038/100	65/85	098/100
KillAll	29.64	004/100	000/100	000/100	003/100	002/100	003/100	002/100	042/100	011/100	042/100	009/100	009/100	011/100	006/100	48/95	047/100	041/100	034/100	025/100	019/100	038/100	073/100	-	039/100	070/100	94/96	095/100
WillyT	27.76	001/100	000/100	000/100	000/100	000/100	000/100	000/100	026/100	000/100	008/100	007/100	014/100	065/100	051/100	08/93	077/100	005/100	042/100	059/100	004/100	022/100	039/100	061/100	-	043/100	85/93	100/100
AILien	27.01	000/100	000/100	00/99	000/100	002/100	000/100	003/100	013/100	007/100	027/100	012/100	49/99	008/100	038/100	33/95	009/100	037/100	010/100	030/100	036/100	034/100	062/100	030/100	057/100	-	87/91	100/100
CUNYBot	9.84	02/96	000/100	01/98	00/92	00/99	00/96	07/96	08/97	09/96	12/91	05/96	02/92	04/99	06/94	12/92	08/76	00/95	04/87	10/99	13/92	10/89	20/85	02/96	08/93	04/91	-	80/84
Hellbot	1.36	000/100	000/100	000/100	000/100	000/100	000/100	000/100	000/100	000/100	001/100	000/100	000/100	000/100	000/100	01/88	000/100	000/100	005/100	002/100	006/100	007/100	004/100	005/100	000/100	000/100	04/84	-

5.1 HYBRID REASONING SYSTEMS

4. Co-operating Experts

- **Use case: StarCraft Multi-Agent Systems**



5.1 HYBRID REASONING SYSTEMS

Summary

- Hybrid Systems offer solutions to a greater range of problems: "**The sum is greater than the parts**".
- Four categories of typical hybrid system architectures have been introduced. These are not exhaustive: **Other patterns are possible.**
- **Software integration** can be problematic, but it's becoming increasing easier.
- **System modelling** is the most important task.
- **(Multi-)Agent** technology offers flexibility and possibility to build hybrid distributed intelligent systems, which can be both proactive and responsive for real-time use cases.

5.1 HYBRID REASONING SYSTEMS

Exercise

- A soup manufacturer plans to produce a new type of canned soup. The new soup will contain up to **27** ingredients, namely **10** types of meat/fish, **7** types of vegetables, **5** flavour enhancers, **3** types of preservative, salt and sugar.
- To determine the relative quantities of each of the ingredients, the company conducts a market survey. Several hundred volunteers taste various prototype soups in which the **27** ingredients are mixed in different ratios, e.g. **30%** chicken feet, **14%** fish eyes, **15%** turnips. Each taster is given **5** prototype soups to taste and asked to assign each to one of **7** categories.

7 Categories for describing the prototype soup

(a) horrible taste
(b) would only eat if very hungry
(c) weak taste
(d) average taste
(e) good taste
(f) very good taste
(g) heavenly taste

Class Discussion

- Suggest a top-level design for a hybrid system that uses the results of the market survey to determine the mix of raw ingredients likely to achieve the highest consumer rating.

5.1 HYBRID REASONING SYSTEMS

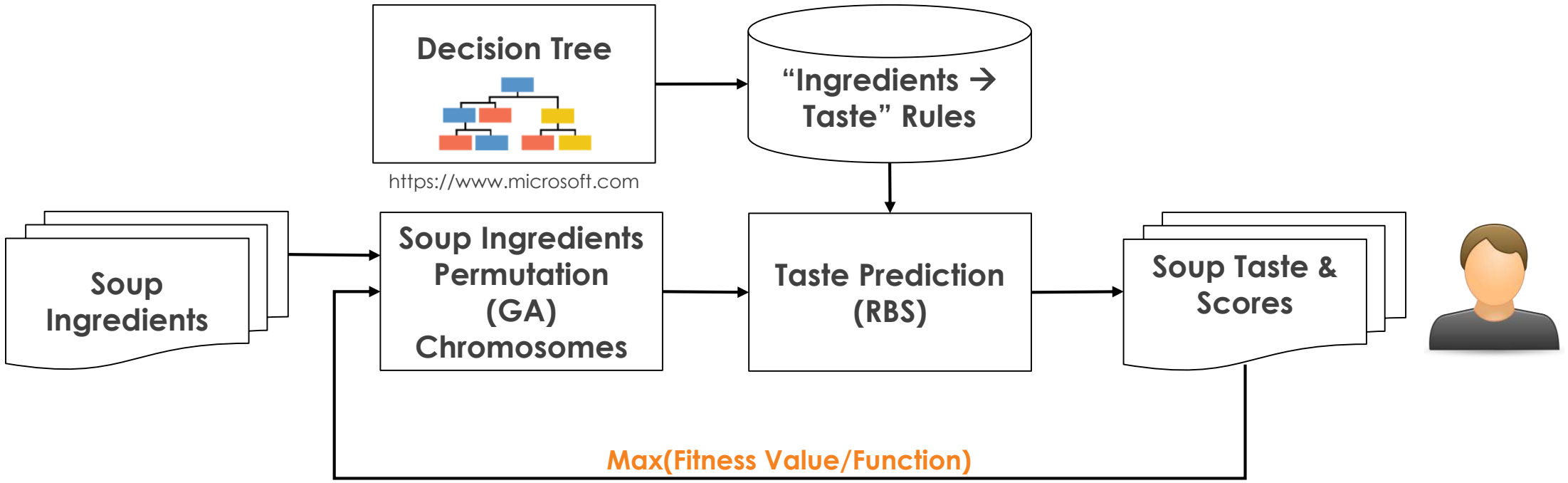
- **Draw** a block diagram of your system. Label each module with the intelligent system technique that is being performed, e.g. Heuristic Search, GA, Decision Tree, etc. Indicate clearly the inputs and outputs of each module.
- **Explain** in words how the system will operate, e.g. how would it determine the best mix of raw ingredients from the results of the market survey.
- **Suggest** how the market survey data can be pre-processed in order to normalise across the different surveyed soup-tasters, e.g. eliminate the variation in soup scores due to the overall bias of the person doing the tasting, e.g. one person may dislike all soups and so score all sampled soups lower than others.

5.1 HYBRID REASONING SYSTEMS

Possible solution:

To Find Best Soup Receipt (Ingredients)

Decision Tree + Rule Based System + Genetic Algorithms



5.2

CONTEMPORARY REASONING SYSTEMS

5.2 CONTEMPORARY REASONING SYSTEMS

- **Question Answering System: IBM Debater**

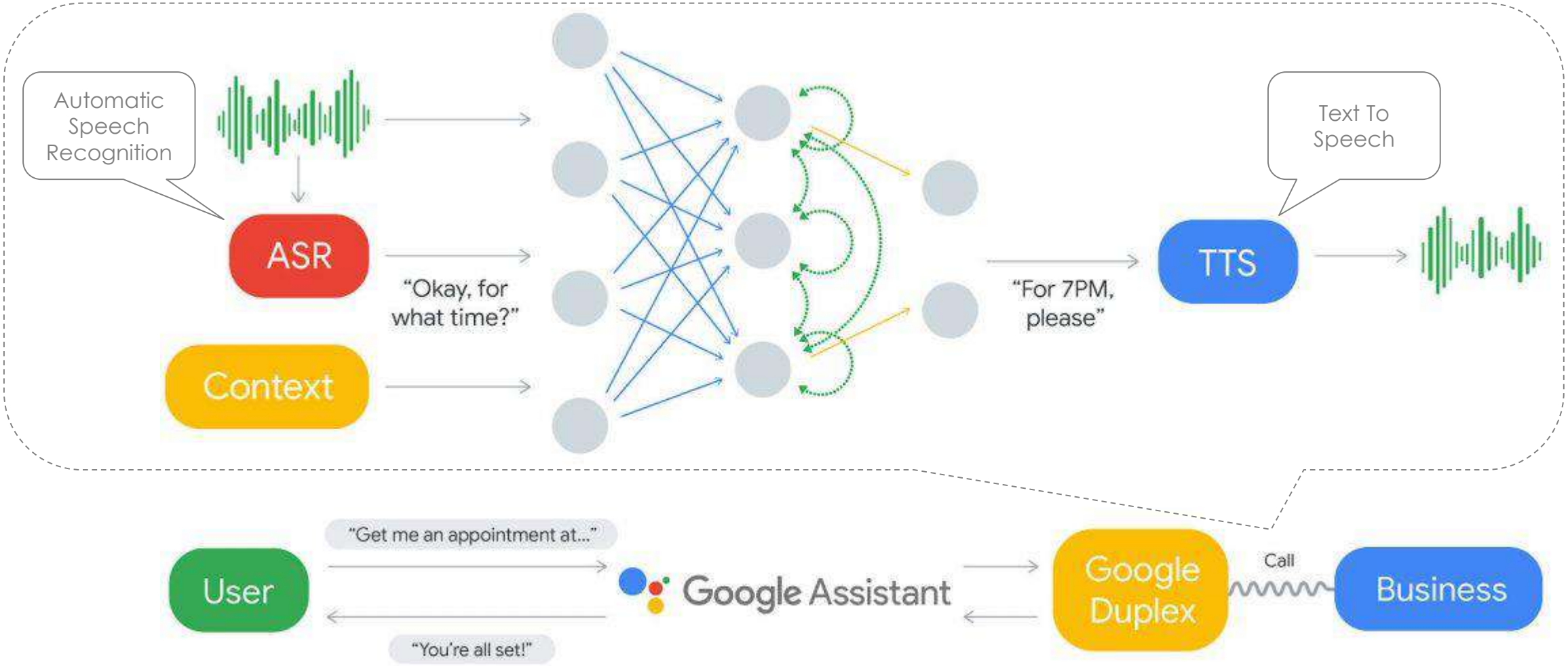
IBM Project Debater

Aragon Research

https://www.youtube.com/watch?v=cBBREqCyDj4

5.2 CONTEMPORARY REASONING SYSTEMS

- **Intelligent Assistant: Google Assistant Duplex**



5.2 CONTEMPORARY REASONING SYSTEMS

- **Intelligent Assistant: Mycroft (open source)**

https://github.com/MycroftAI

Source https://www.kickstarter.com/projects/aiforeveryone/mycroft-an-open-source-artificial-intelligence-for

5.2 CONTEMPORARY REASONING SYSTEMS

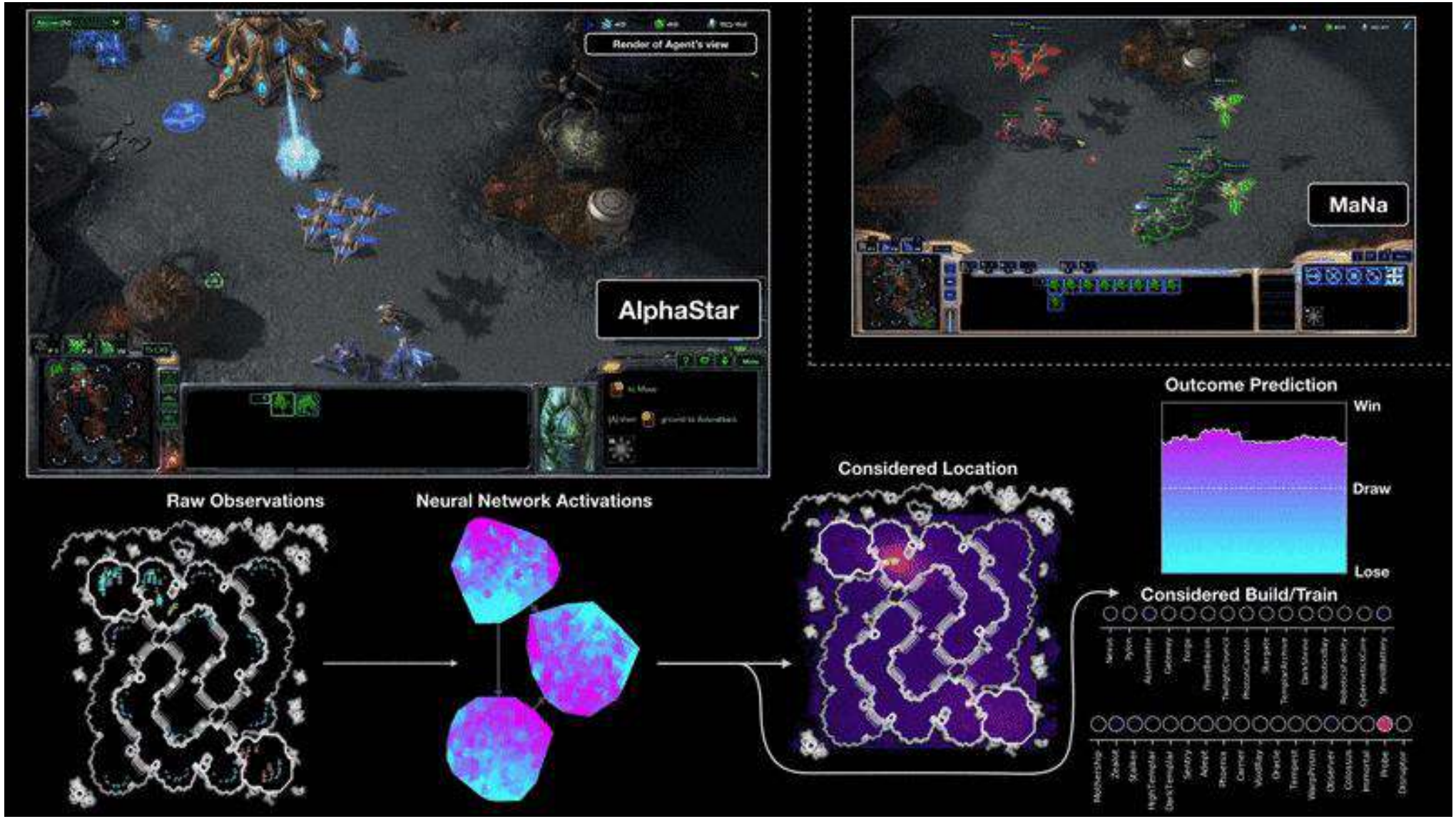
- **Game AI: DeepMind StarCraft Agent System**

Source https://deepmind.com/blog/deepmind-and-blizzard-open-starcraft-ii-ai-research-environment/
Source https://github.com/davechurchill/commandcenter

5.2 CONTEMPORARY REASONING SYSTEMS

Source https://deepmind.com/blog/alphastar-mastering-real-time-strategy-game-starcraft-ii/

5.2 CONTEMPORARY REASONING SYSTEMS



Source https://deepmind.com/blog/alphastar-mastering-real-time-strategy-game-starcraft-ii/

5.2 CONTEMPORARY REASONING SYSTEMS

- **Game AI: DeepMind AlphaGo Zero**

Reinforcement Learning
https://deepmind.com/blog/alphago-zero-learning-scratch/
https://telescopeuser.wordpress.com/

DiDi: A Reinforcement Learning Agent

Reinforcement Learning in Daily Life

[Author: DiDi & GU Zhan (Sam)]

[Tags: MTech IS, AI, Reinforcement learning, Agent, Markov decision process]

5.3
COURSE ASSESSMENT

LumiNUS

Gu Zhan

MY MODULES | MODULE SEARCH | CONTENT BANKS | RESEARCH RECRUITMENT | GUESTS & GROUPS | STUDENT FEEDBACK

ISY5001

Intelligent Reasoning Systems - Reasoning Systems

Owner

TOOLS

- Announcements
- Chat
- Conferencing
- Consultation
- Files
- Forum
- Gradebook
- Multimedia

Files

Search files

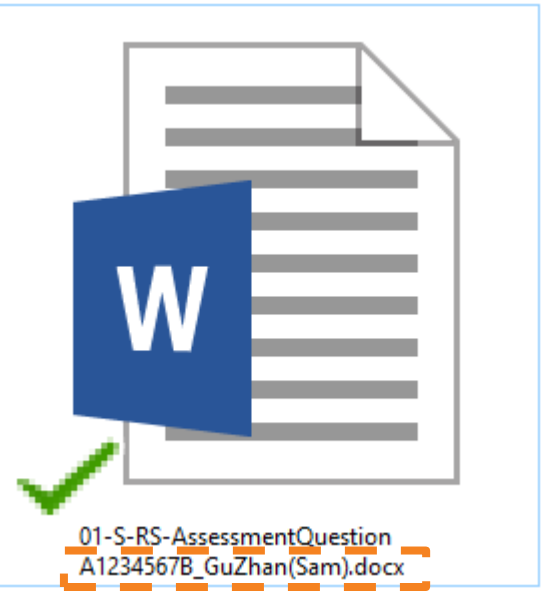
Name	Opening Date	Expiry Date	Status
Reasoning Systems 01 - Courseware			Open
Reasoning Systems 02 - Workshop n Project			Open
Reasoning Systems 02 - Workshop n Project Submission			Open
Reasoning Systems 03 - Assessment			Open
Reasoning Systems 03 - Assessment Submission			Open

Create Folder

Rearrange

Bulk Create Folders

My Activity Log



Upload word, pdf or zip file to LumiNUS (one single file per participant)

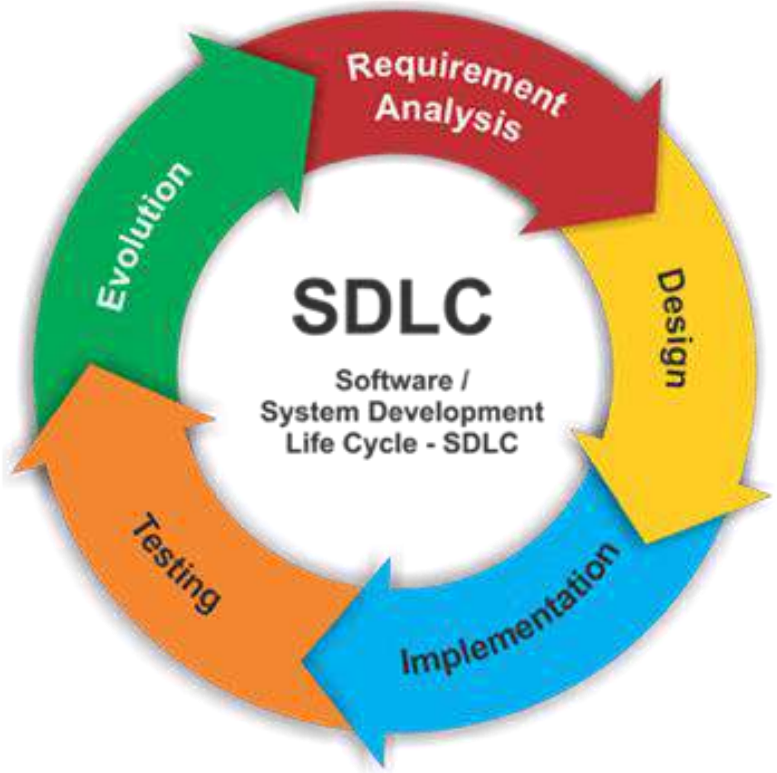
5.4 WORKSHOP

CREATE HYBRID REASONING SYSTEM

(GRADED WORKSHOP & PROJECT DELIVERABLES)

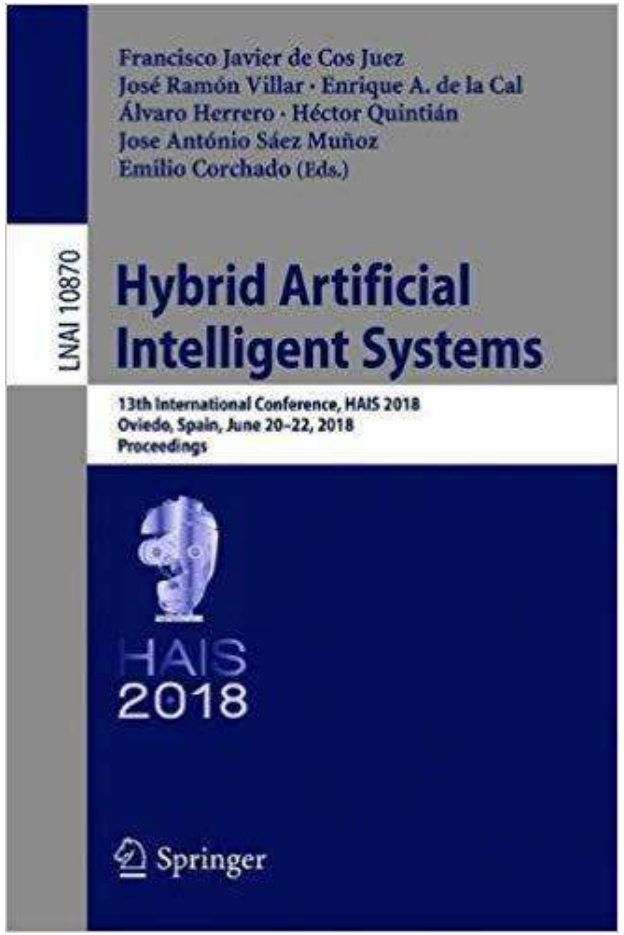
5.3 WORKSHOP CREATE HYBRID REASONING SYSTEM

- **Requirement Analysis**
  - Problem selection: Identify business value and purposes
- **Design (Problem Modelling & Representation)**
  - Technical definition of problem domain
  - System design
- **Implementation**
  - System development
- **Testing**
  - Integrate, test, revise, deploy, and use
- **Evolution**



https://i1.wp.com/melsatar.blog/wp-content/uploads/2012/03/sdlc.png?fit=830%2C374&ssl=1

DAY 5 REFERENCE



1. Ahmed Thanyan AL-Sultan. (2012). The Airport Gate Assignment Problem: Scheduling Algorithms and Simulation Approach

   http://ousar.lib.okayama-u.ac.jp/files/public/4/48534/20160528091554614463/K0004584_honbun.pdf

2. Approximate string matching (Fuzzy Matching)

   https://en.wikipedia.org/wiki/Approximate_string_matching

3. Introduction to the A* Algorithm from Red Blob Games

   https://www.redblobgames.com/pathfinding/a-star/introduction.html

4. Constraint Satisfaction Problems

   http://www.cse.chalmers.se/edu/year/2013/course/TIN171/slides/chapter06.pdf

5. GU Zhan, et al. (2016). Application of data mining techniques to build master plant relationships based on heterogeneous databases

   https://ieeexplore.ieee.org/document/7848002/authors#authors

END OF LECTURE NOTES

APPENDICES

The right A.I. for the job

One Artificial Intelligence algorithm does not fit all use cases.

Vector Space Model

Full text search

"cat"

The secret life of felines
felines.pdf
Felines, or **cats** as they are more commonly known, are carnivorous ...

Other use cases include:
recommendations, similarties, ...

Implemented by:

Lucene

Neural Net

Image recognition

"Dog"

Other use cases include:
voice recognition, machine translation, ...

Implemented by:
TensorFlow, Deeplearning4j

Constraint Solver

Vehicle routing problem

15% less driving time

Other use cases include:
employee rostering, job scheduling, ...

Implemented by:
OptaPlanner

Other algorithms for other use cases:
A* Search for pathfinding, Rete/Phreak for production rule systems, k-means for cluster analysis, ...

http://www.optaplanner.org/learn/slides.html

END OF APPENDICES