University of
Central Lancashire
UCLan

CO3519
Artificial Intelligence

Module structure
Aims and decisions

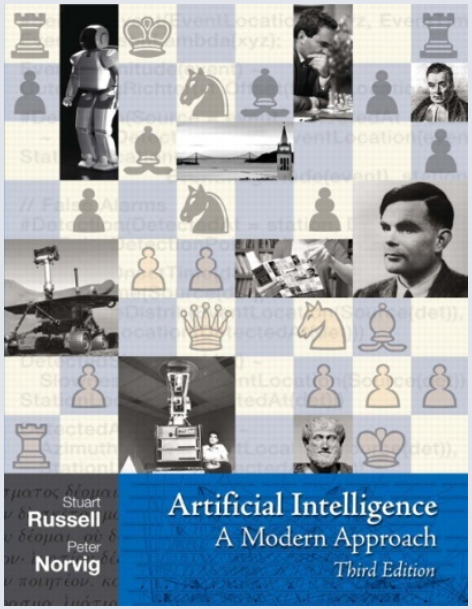
Where opportunity creates success

University of Central Lancashire
UCLan

Resources

Recommended literature:

- S. Russell, P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th edn. (global), Harlow: Pearson (ISBN 978-1-29240113-3), **2021**.



University of Central Lancashire
UCLan

Resources

Recommended literature:

- S. Russell, P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th edn. (global), Harlow: Pearson (ISBN 978-1-29240113-3), **2021**.

Additional references for special topics, *e.g.*, today:

- G. T. Doran, "There's a S.M.A.R.T. way to write management's goals and objectives," *Management Review* 70(11), 35–36, **1981**.
- D. M. Wegner, "The mind's best trick: How we experience conscious will," *Trends in Cognitive Sciences* 7(2), 65–69, **2003**.

University of Central Lancashire
UCLan

Resources

Recommended literature:

- S. Russell, P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th edn. (global), Harlow: Pearson (ISBN 978-1-29240113-3), **2021**.

Additional references for special topics, *e.g.*, today:

- G. T. Doran, "There's a S.M.A.R.T. way to write management's goals and objectives," *Management Review* 70(11), 35–36, **1981**.
- D. M. Wegner, "The mind's best trick: How we experience conscious will," *Trends in Cognitive Sciences* 7(2), 65–69, **2003**.

Course website:

- https://home.bawue.de/~horsch/teaching/co3519/

All essential information will be made accessible through the course website.

University of Central Lancashire
UCLan

Module structure

CO3519

5th October 2021

University of Central Lancashire
UCLan

Learning outcomes

Upon successful completion of this module, a student will be able to:

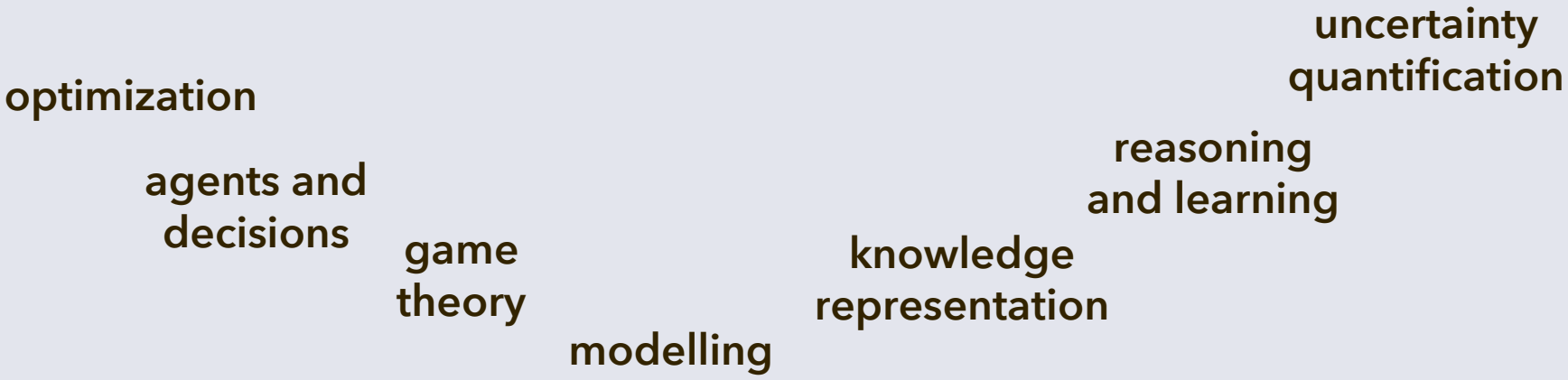
1) Explain the theoretical underpinnings of algorithms and techniques specific to artificial intelligence;
2) Critically evaluate the principles and algorithms of artificial intelligence;
3) Analyse and evaluate the theoretical foundations of artificial intelligence and computing;
4) Implement artificial intelligence algorithms.

University of Central Lancashire
UCLan

Learning outcomes

Upon successful completion of this module, a student will be able to:

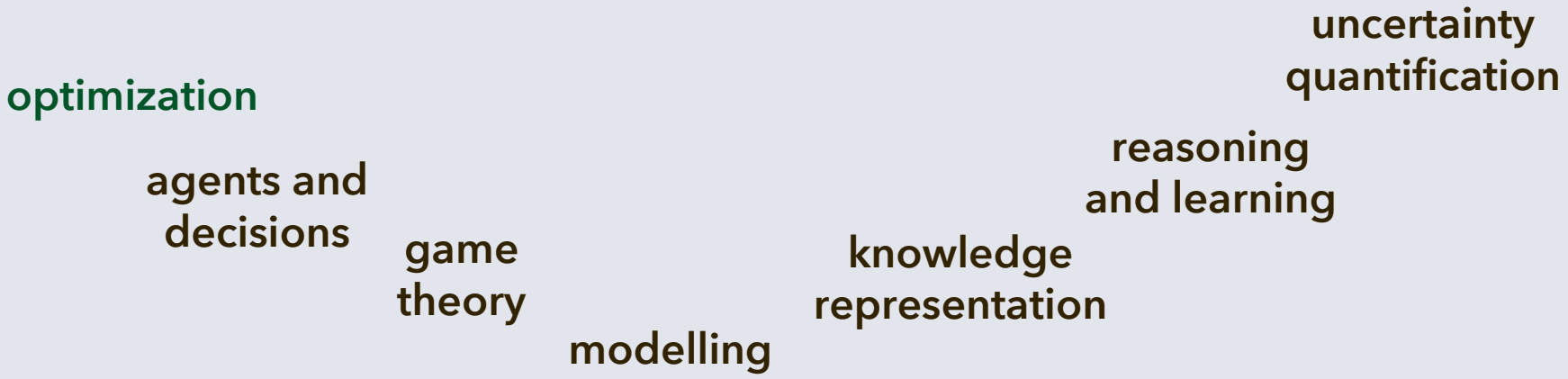
1) Explain the theoretical underpinnings of algorithms and techniques specific to artificial intelligence;
2) Critically evaluate the principles and algorithms of artificial intelligence;
3) Analyse and evaluate the theoretical foundations of artificial intelligence and computing;
4) Implement artificial intelligence algorithms.



Module structure

On the field of **optimization**, we will:

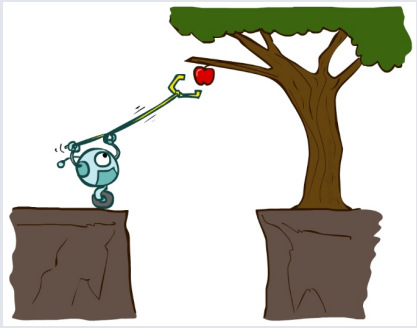
- Discuss the characteristics of common optimization problems and the associated objective spaces and design spaces;
- Apply multicriteria optimization based on characterizing the Pareto set;
- Consider a series of example use cases.

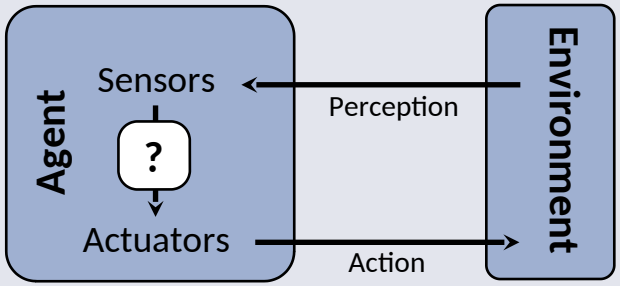


Module structure

On the field of **agents and decisions**, we will:

- Review common definitions of agency and knowledge-based intelligent agents;
- Discuss the use of AI in assisting human decision making;
- Consider philosophical issues pertaining to the field, such as explainable AI and epistemic opacity.





agents and decisions

game theory

modelling

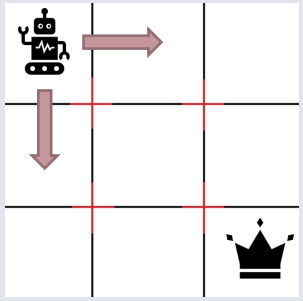
knowledge representation

reasoning and learning

Module structure

On the field of **game theory**, we will:

- Introduce mathematical formalisms used in game theory;
- Characterize optimal strategies depending on boundary conditions;
- Use graphical notations including influence maps and behaviour trees.



optimization

agents and decisions

game theory

modelling

knowledge representation

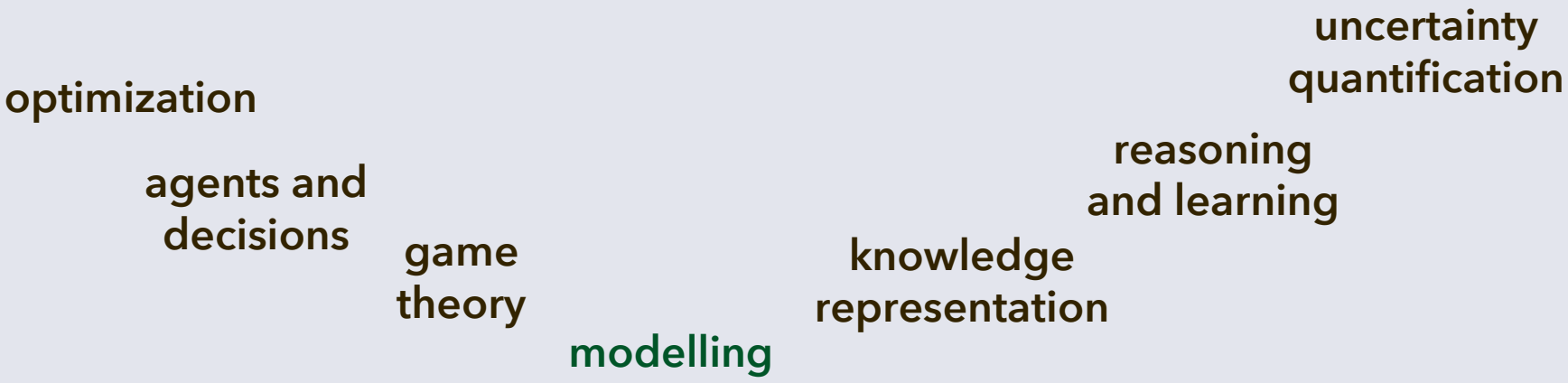
reasoning and learning

uncertainty quantification

Module structure

On the field of **modelling**, we will:

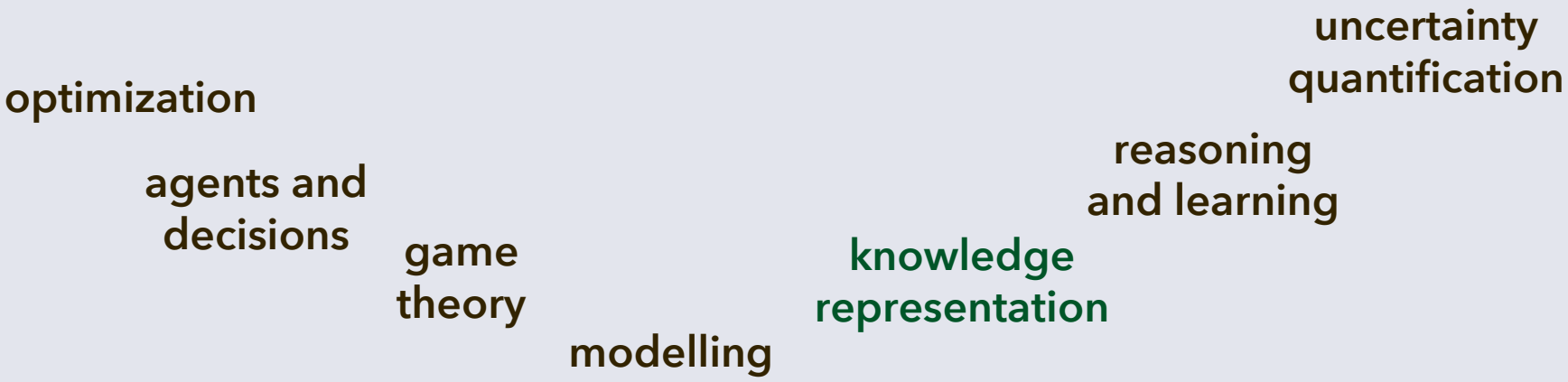
- Discuss the use of models in optimization and decision support;
- Apply optimization algorithms to model parameterization;
- Assess model quality by validation and testing.



Module structure

On the field of **knowledge representation**, we will:

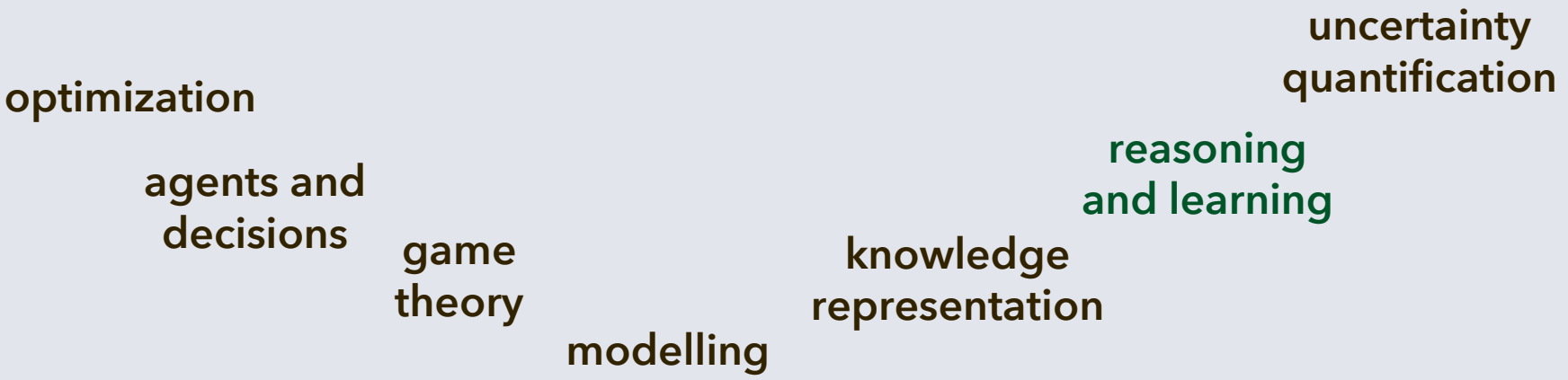
- Introduce the required logical framework based on first-order logic;
- Work with description logic, a decidable fragment of FO logic that is tailored to practical requirements in conceptual modelling;
- Implement knowledge bases using RDFS and OWL technology.



Module structure

On the field of **reasoning and learning**, we will:

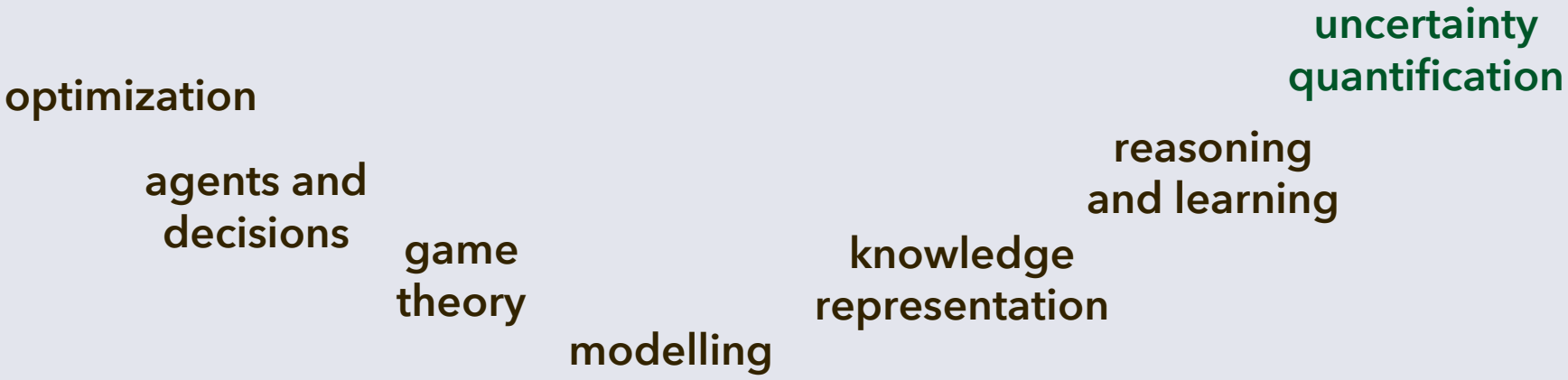
- Discuss approaches to **deductive reasoning** based on logic …
- … and approaches to **inductive reasoning** based on machine learning.



Module structure

On the field of **uncertainty quantification**, we will:

- Discuss good practices in specifying and dealing with uncertainty;
- Introduce probability assertion formalisms for representing uncertain knowledge and review foundations of probability theory;
- Apply Bayesian methods to reasoning over uncertain knowledge.



Module structure

On the field of **uncertainty quantification**:

- Discuss good practices in specifying and dealing with uncertainty;
- Introduce probability assertion formalisms for representing uncertain knowledge and review foundations of probability theory;
- Apply Bayesian methods to reasoning over uncertain knowledge.

Grading

Number of Assessments	Form of Assessment	% weighting	Size of Assessment/ Duration/ Wordcount	Category of assessment	Learning outcomes being assessed
1	Examination	40%	1.5 hours	Written exam	1,2
1 (split into parts)	Practical work involving the selection, implementation and evaluation of algorithms and data structures	60%	2,000 words equivalent	Coursework	1,2,3

To pass this module, you must achieve a grade of 40% or above aggregated across all the assessments.

University of Central Lancashire
UCLan

Programming practice

The official programming language of the module is Python.

University of Central Lancashire
UCLan

Programming practice

The official programming language of the module is Python.

However, Artificial Intelligence is a theoretical course.

It does not matter what programming languages or environments you use for purposes of AI method and algorithm implementation or problem solving.

Any code that is well written and documented will be accepted as part of the solution to a problem from our practical/tutorial sessions.

University of Central Lancashire
UCLan

Programming practice

The official programming language of the module is Python.

However, Artificial Intelligence is a theoretical course.

It does not matter what programming languages or environments you use for purposes of AI method and algorithm implementation or problem solving.

Any code that is well written and documented will be accepted as part of the solution to a problem from our practical/tutorial sessions. If it does not run on my system (a rather average Linux installation) or if there are any other issues due to the employed environment, I may ask for clarification, e.g., by demonstrating your solution on the system where it was implemented.

In extreme, unexpected cases you may be required to rewrite code in Python.

University of Central Lancashire
UCLan

Aims and decisions

CO3519

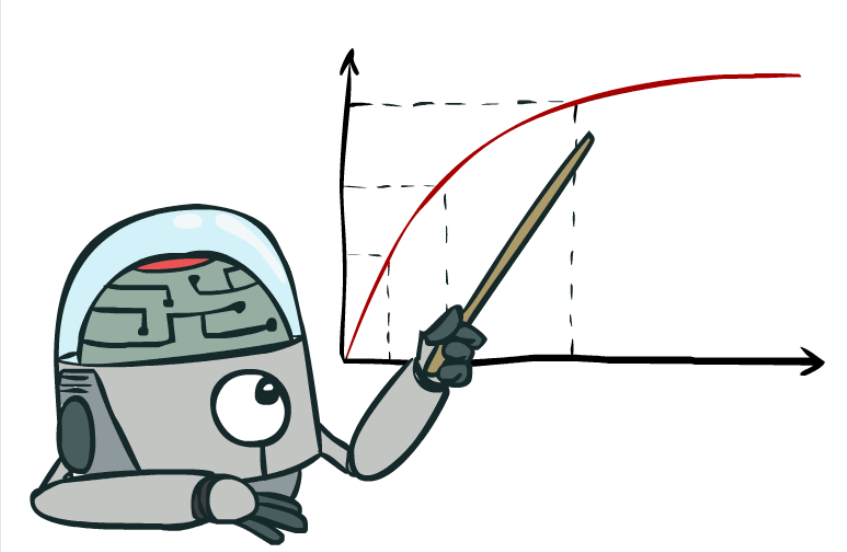
5th October 2021

University of Central Lancashire
UCLan

Aims and decision making

Decision making requires a field of action within which an agent is free to choose. This can be formalized as a **design space**; also, **parameter space** if it reduces to selecting values for a set of free variables.

A rational agent determines and pursues the best course of action, which is often represented in terms of **optimization criteria**, defining an **objective space**.



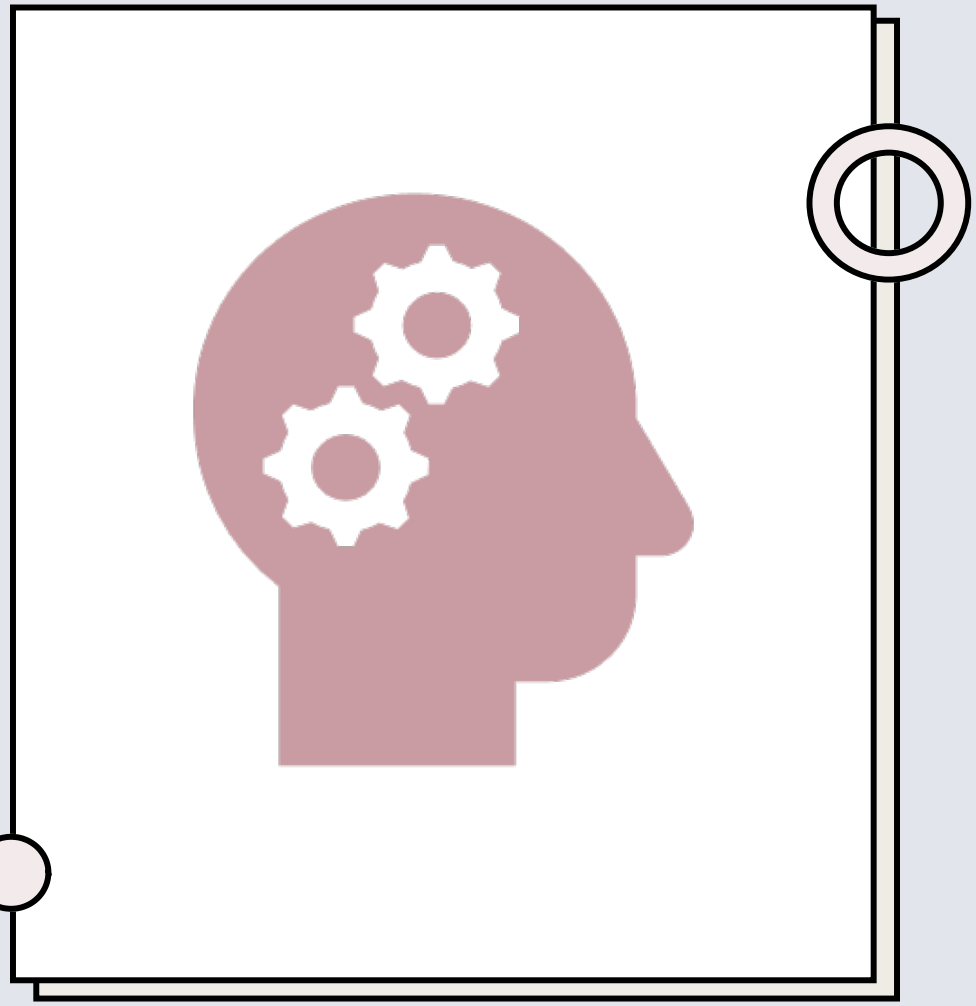
University of Central Lancashire
UCLan

Aims and decision making … in humans

Decision making requires a field of action within which an agent is free to choose. This can be formalized as a **design space**; also, **parameter space** if it reduces to selecting values for a set of free variables.

A rational agent determines and pursues the best course of action, which is often represented in terms of **optimization criteria**, defining an **objective space**.

Human agency: Influence of **unconscious bias** and **unconscious goals**.



Aims and decision making … in humans

"Does consciousness cause action?

Many people think that even asking this question is absurd. How could consciousness not cause what we do? Every few moments of every day, we think about doing something and then do it. We think of moving a finger and then do it, we think of going to the store for milk and do it […]. It certainly doesn't take a rocket scientist to draw the obvious conclusion […]: consciousness is an active force, an engine of will.

The mind has been known to play tricks, though. Could this be one?"
(Wegner, 2003)

Human agency: Influence of **unconscious bias** and **unconscious goals**.

D. M. Wegner, *Trends in Cognitive Sciences* 7(2), 65–69, **2003**.

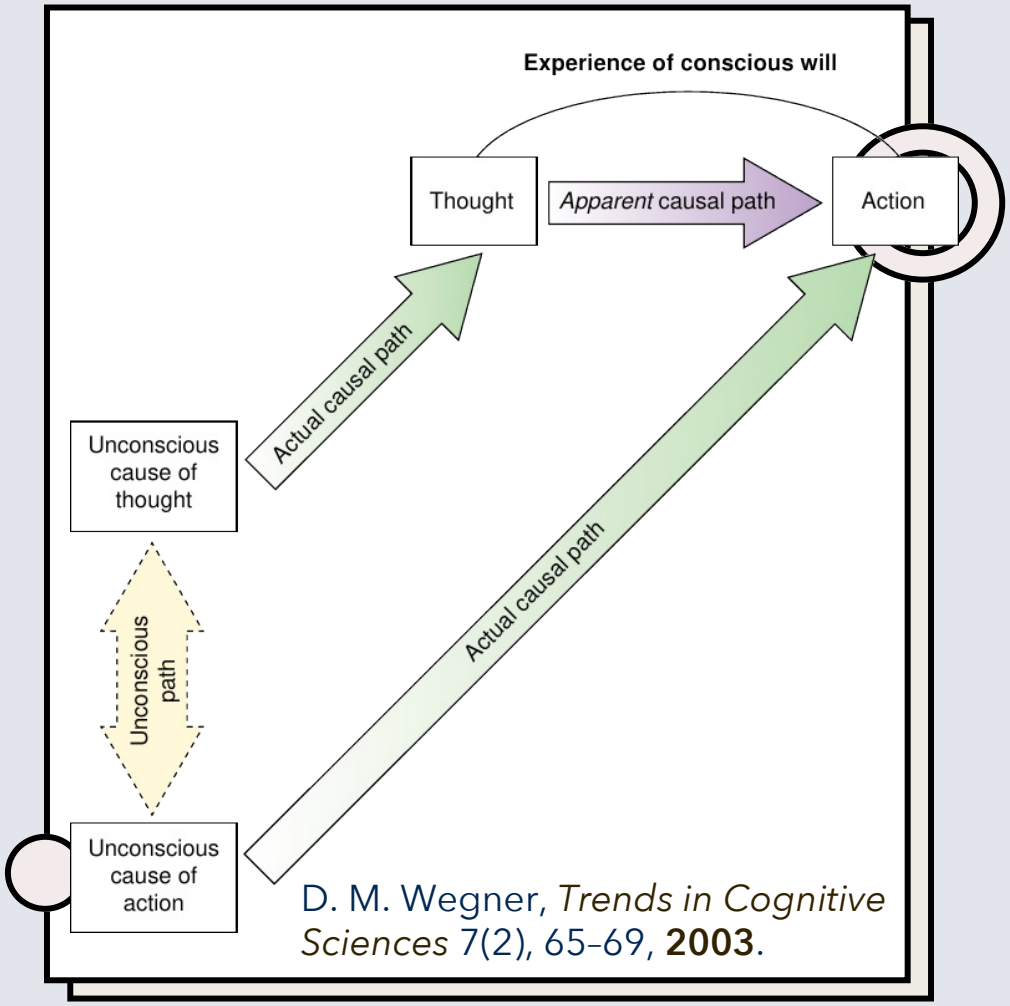
Aims and decision making … in humans

"Does consciousness cause action?

Many people think that even asking this question is absurd. How could consciousness not cause what we do? Every few moments of every day, we think about doing something and then do it. We think of moving a finger and then do it, we think of going to the store for milk and do it […]. It certainly doesn't take a rocket scientist to draw the obvious conclusion […]: consciousness is an active force, an engine of will.

The mind has been known to play tricks, though. Could this be one?"
(Wegner, 2003)

Human agency: Influence of **unconscious bias** and **unconscious goals**.



D. M. Wegner, *Trends in Cognitive Sciences* 7(2), 65–69, **2003**.

Aims and decision making … in humans

Song by Walther von der Vogelweide (~ 1200)

Ich saz ûf eime steine
und dahte bein mit beine.
Dar ûf satzt ich den ellenbogen.
Ich hete in mîne hant gesmogen
daz kinne und ein mîn wange.
Dô dâhte ich mir vil lange
wie man zer welte solte leben.

I sat upon a rock and crossed my legs.
I rested my elbow upon them, and held
chin and cheek inside my hand.
Then I thought for a very long time about
how one should lead one's life on earth.

Aims and decision making … in humans

Song by Walther von der Vogelweide (~ 1200)

Deheinen rât kond ich gegeben,
wie man driu dinc erwurbe,
der keines niht verdurbe.
Diu zwei sint **êre** *und* **varnde guot**,
daz dicke ein ander schaden tuot:
daz dritte ist **gotes hulde**,
der zweier übergulde.

I could not advise on how to acquire
three things without destroying any.
Two are **honour** and **mobile possessions**,
which heavily harm each other.
The third is the **grace of God**,
worth more than the two.

Aims and decision making … in humans

Song by Walther von der Vogelweide (~ 1200)

Diu wolte ich gerne in einen schrîn.
Jâ leider des enmac niht sîn,
daz **guot** *und* **weltlich êre**
und **gotes hulde** *mêre*
zesamene in ein herze komen.

These I would like to have in one box.
But sadly that may not be,
that **goods** and **worldly honour**,
and **God's grace** additionally,
come together in a single heart.

BASF SE strategy statement

Our Strategy

At BASF, we are passionate about chemistry and our customers. To be the world's leading chemical company for our customers, we will grow profitably and create value for society. Thanks to our expertise, our innovative and entrepreneurial spirit, and the power of our Verbund integration, we make a decisive contribution to changing the world we live in for the better. This is our goal. This is what drives us and what we do best: We create chemistry for a sustainable future.

BASF Group at a Glance

Read more about BASF's performance in 2019.

Download brochure

Today, the world is changing more rapidly than ever before, driven by demographic change and new digital technologies. Our customers in different industries and regions face diverse social and environmental challenges due to limited natural resources, climate change and the increasing demands of a growing global population. Chemistry is key to solving many of these challenges. By combining our unique expertise with our customers' competence, we can jointly develop profitable, innovative and sustainable solutions for these global challenges.

BASF SE strategy statement

Our Strategy

At BASF, we are passionate about chemistry and our customers. To be the world's leading chemical company for our customers, we will grow profitably and create value for society. Thanks to our expertise, our innovative and entrepreneurial spirit, and the power of our Verbund integration, we make a decisive contribution to changing the world we live in for the better. This is our goal. This is what drives us and what we do best: We create chemistry for a sustainable future.

- be the world's leading company
- grow profitably and create value
- changing the world […] for the better

BASF Group at a Glance

Read more about BASF's performance in 2019.

Download brochure

Today, the … d new digital technologies. Our customers in different in… d natural resources, climate change and the increasing demands of a growing global population. Chemistry is key to solving many of these challenges. By combining our unique expertise with our customers' competence, we can jointly develop profitable, innovative and sustainable solutions for these global challenges.

BASF SE strategy statement

Our Strategy

At BASF, we are passionate about chemistry and our customers. To be the world's leading chemical company for our customers, we will grow profitably and create value for society. Thanks to our expertise, our innovative and entrepreneurial spirit, and the power of our Verbund integration, we make a decisive contribution to changing the world we live in for the better. This is our goal. This is what drives us and what we do best: We create chemistry for a sustainable future.

BASF Group at a Glance

Read more about BASF's

- be the world's leading company
- grow profitably and create value
- changing the world […] for the better
- honour
- goods
- God's grace

Today, the customers in different in ge and the increasing demands of a growing global population. Chemistry is key to solving many of these challenges. By combining our unique expertise with our customers' competence, we can jointly develop profitable, innovative and sustainable solutions for these global challenges.

University of Central Lancashire
UCLan

SMART objectives

In AI-driven decision support (and otherwise in business administration), optimization objectives are often referred to as

key performance indicators (KPIs).

KPIs are usually required to be **SMART objectives**,[1] i.e.,

SMART objectives

In AI-driven decision support (and otherwise in business administration), optimization objectives are often referred to as

key performance indicators (KPIs).

KPIs are usually required to be **SMART objectives**,[1] i.e.,

*"***Specific** – *target a specific area for improvement.*
Measureable – *quantify or at least suggest an indicator of progress.*
Assignable – *specify who will do it.*
Realistic – *state what […] can […] be achieved, given available resources.*
Time-related – *specify when the result(s) can be achieved" (Doran, 1981).*

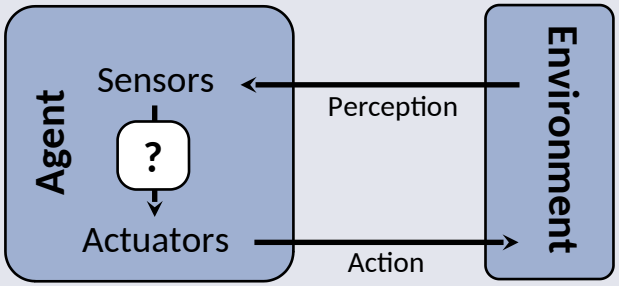
[1] G. T. Doran, *Management Review* 70(11), 35–36, **1981**.

University of Central Lancashire
UCLan

SMART objectives

In AI-driven decision support (and otherwise in business administration), optimization objectives are often referred to as

key performance indicators (KPIs).



KPIs are usually required to be **SMART objectives**,[1]

"Specific – target a specific area for improvement.
Measureable – *quantify or* **at least suggest an indicator of progress**.
Assignable – specify who will do it.
Realistic – state what […] can […] be achieved, given available resources.
Time-related – specify when the result(s) can be achieved" (Doran, 1981).

[1]G. T. Doran, *Management Review* 70(11), 35–36, **1981**.

University of
Central Lancashire
UCLan

CO3519
Artificial Intelligence

Module structure
Aims and decisions

Where opportunity creates success