INFOMSCIP 2019-2020
lecture 1
Sep 5, 2019

Scientific perspectives on GMT (INFOMSCIP)

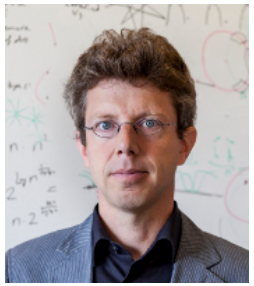
Introduction

- Administration & organizational remarks
  Lectures & assignments, grading
- Science & the scientific method
  What is it? What is unique about it?
  What methods are used in GMT?

INFOMSCIP

Mandatory 1st year course
in GMT master, 7.5 ECTS

Marc van Kreveld



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When emailing us, start your **subject** with **[INFOMSCIP]** followed by a description of the content!

Thu, Sep 5	Introduction	*Wolfgang*
Mon, Sep 9	Level difficulty of games	*Marc*
Thu, Sep 12	Guest lectures	*Organized by Marc*
Mon, Sep 16	Experimental research I	*Marc*
	Deadline assignment 1	
Thu, Sep 19	Experimental research II	*Marc*
Mon, Sep 23	Fundamental research	*Marc*
Thu, Sep 26	Fundam. research: graph drawing	*Marc*
	Deadline assignment 2	
Mon, Sep 30	Measures	*Marc*
Thu, Oct 3	Visual analytics	*Marc*
	Deadline assignment 3	
Mon, Oct 07	Benchmark testing	*Wolfgang*
Thu, Oct 10	Benchmark testing	*Wolfgang*
	Deadline assignment 4	
Mon, Oct 14	Empirical research	*Wolfgang*
Thu, Oct 17	Empirical research	*Wolfgang*
	Deadline assignment 5	
Mon, Oct 21	User studies	*Wolfgang*
Thu, Oct 24	User studies	*Wolfgang*
	Deadline assignment 6	
Mon, Oct 28	Engineering, design, systems	*Wolfgang*
Thu, Oct 31	Engineering, design, systems	*Wolfgang*
	Deadline assignment 7	
Thu, Nov 7	Deadline assignment 8	

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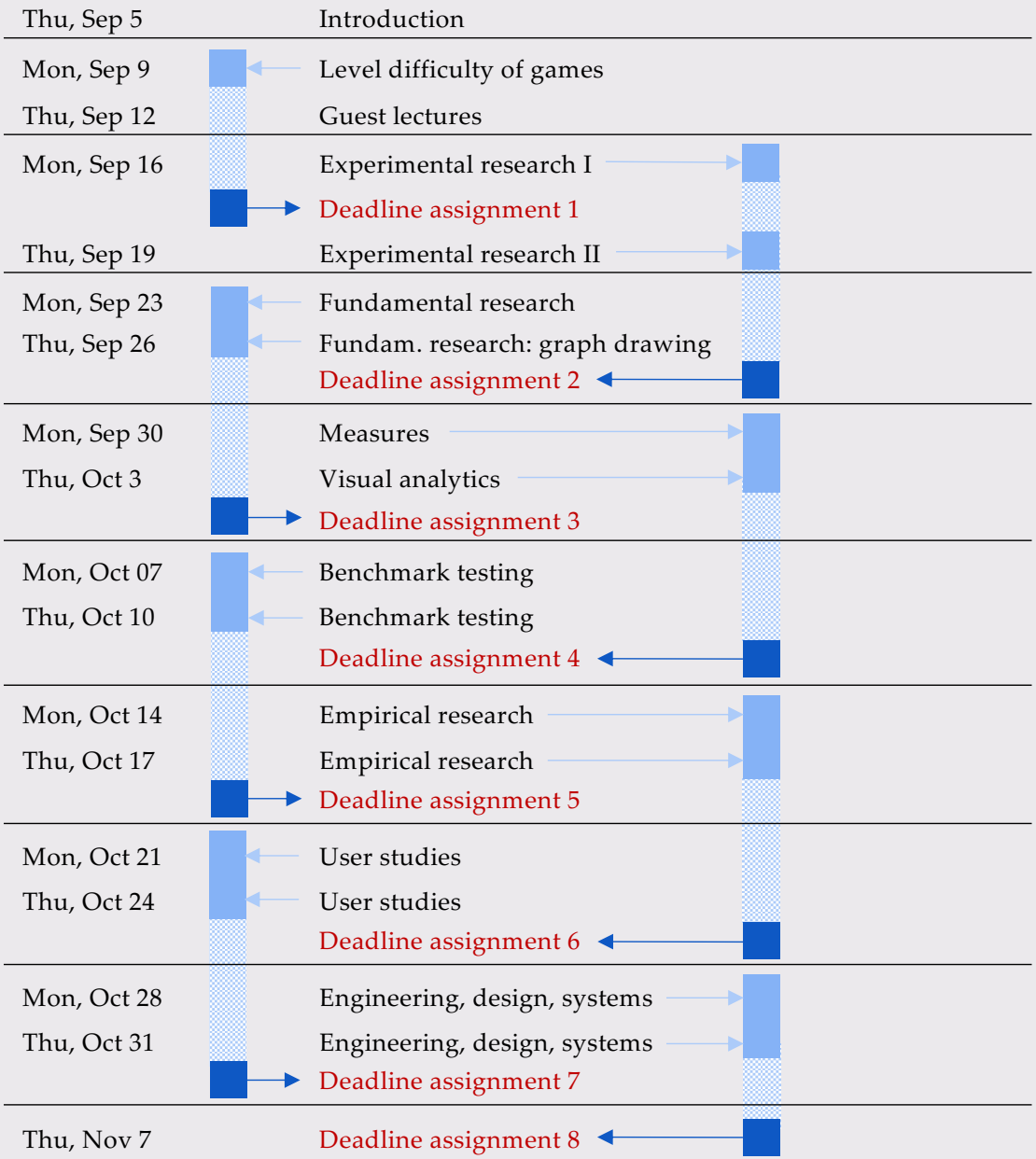
Lectures
(attendance mandatory)

Lectures
(Mon & Thu)

Assignments
(basis for grades)

Assignments
(deadline = Thu, 11am,
with one exception)

This is a new course for us, too.
Things can (and will) go wrong.
Your understanding and
feedback is highly appreciated.



Comments from last year's evaluation

Lectures in a master program should not be mandatory.
The lectures are pointless if there is no exam.

Changes this year

You can choose:

- Either attend all lectures (2 times absence is tolerated)

  Attendance lists will be passed around at random times during each lecture.

- Or do an exam at the end (covering the lectures)

  Given the number of students, we reserve the right to make an oral exam.

Students who attend all lectures are welcome to take the exam
if they want to improve their grade.

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Assignments: procedure

Groups of (3-)4 students.

Assigned by us.

Delivered by email,
cc'ed to all group members,
remember the subject!

Group grade
(but individual deductions
or increases are possible).

Exceptions may apply to individual assignments and will be announced in time

E.g.: deadline for 1st is Monday, last one is individual.

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Comments from last year's evaluation

Teams are difficult due to different work ethics.

Talents, commitment, … averages across members; so do grades.

Changes this year

First issues: sorry, but that's part of the learning goals.

Fairer grading:

- Each group member must report their approx. hours with each assignment.
- Students with low commitment (contributions or hours) or bad contributions may get deductions.
- Students with higher commitment (contributions or hours) or better contributions can get higher grades, but must apply for them and justify their claims.

Note that the last assignment will be individual and you can also take the exam to improve your grade.

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Lectures:

Mandatory attendance
or exam at the end

Assignments grade:

Average of 7 best assignments
(plus exam if you take it)

Each of those must
at least be a 5.5

One of the criteria violated:
retake exam in Jan 2020

Both violated: grade is set to
ONV & no retake chance

Check the grading criteria
on the **website** carefully!

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Comments from last year's evaluation

Time too short because we could not meet before Monday's lecture. One assignment per week is very stressful.

Changes this year

None, because both issues are wrong or intended, sorry.

- The schedule is made in a way that you can (and should) meet on Thu.
- 20 hours per week should be enough to do the assignment (& lectures).

European Credit Transfer and Accumulation System (**ECTS**) credits are a standard means for comparing the "volume of learning based on the defined learning outcomes and their associated workload" for higher education across the European Union and other collaborating European countries.

EU: 1 ECTS = 25-30 hours
NL: 1 ECTS = 28 hours

→ 7.5 ECTS = 210 hours

It is a mandatory requirement that you spend at least 20 hours per week for a course that gives you 7.5 ECTS.

End of the organizational part.

Take home messages:

- *Attend the lectures*
- *Do weekly assignments*
- *Stick to the schedule*
- *Have fun & enjoy the course*
- *Tell us if you don't & help improving it*

Any questions, comments, …?

Scientific perspectives on GMT – What & why

- INFOMSCIP = new, mandatory course in GMT master

- GMT master = research master (not a taught master)
  - Self-dependent work
  - Qualification to do research
  - Proven by master thesis at the end

- But what does it mean to do research in GMT?
- And what does it mean to do research in computer science?
- And what does it mean to do research in science?

Comments from last year's evaluation

This course is just for UU students who didn't do a bachelor thesis.

Many students don't want to stay in academia, so why bother?

It only covers the research of the two lecturers.

Comments

No offense, but if you think you know everything about research,
because you did a bachelor thesis, you really should follow this course!

This is a research master. We hope you know what you signed up for, do you?
More importantly, even if you don't do research later,
having an understanding of it is often helpful (and sometimes expected).

The topics covered here should be irrelevant. The focus is on the methodologies.
We must and will highlight this better this year.

Science (from Latin *scientia*, meaning "knowledge") is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe.

…

Science is based on ***research***, which is commonly conducted in academic and research institutions as well as in government agencies and companies.

From Wikipedia.org ("Science")

Research comprises "creative and systematic work undertaken to increase the stock of knowledge, including knowledge of humans, culture and society, and the use of this stock of knowledge to devise new applications."

From Wikipedia.org ("Research")

The **branches of science**, also referred to as sciences, "scientific fields", or "scientific disciplines," are commonly divided into three major groups:

Formal sciences: the study of mathematics and logic, which use an *a priori*, as opposed to factual, methodology.

Natural sciences: the study of natural phenomena (including cosmological, geological, chemical, and biological factors of the universe)

Social sciences: the study of human behavior and societies.

Natural, social, and formal science make up the **fundamental sciences**, which form the basis of **interdisciplinary** and **applied sciences** such as engineering and medicine.

From Wikipedia.org ("Branches of science")

Computer science: part of applied sciences
Theoretical computer science: part of formal sciences

Scientific research involves using the scientific method, which seeks to objectively explain the events of nature in a reproducible way.

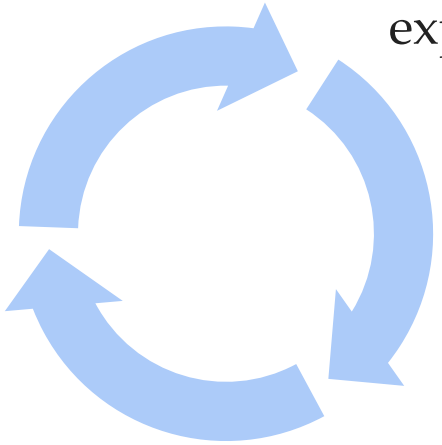
From Wikipedia.org ("Science")

Hypotheses (theoretical, hypothetical explanations of observations and measurements of the subject)

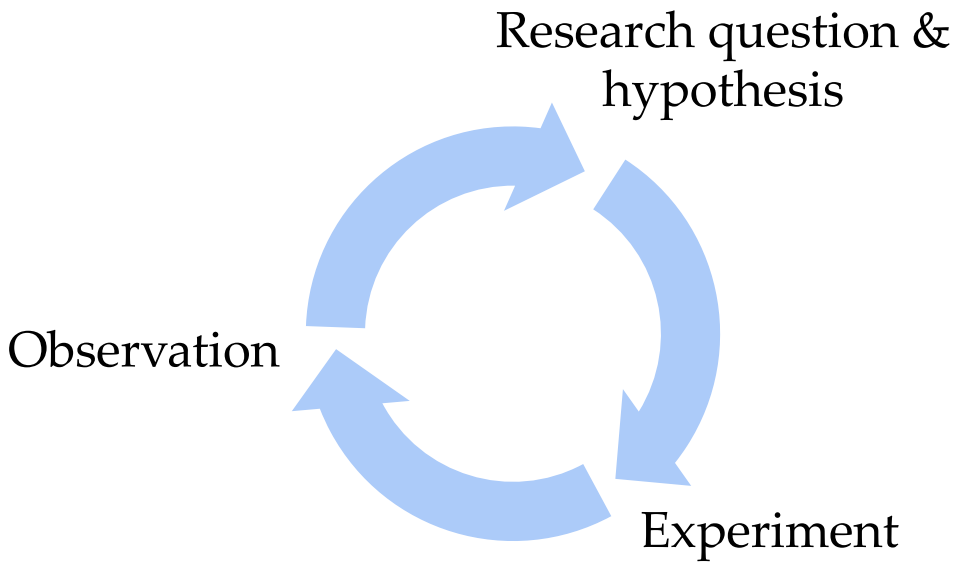
Predictions (inductive and deductive reasoning from the hypothesis or theory)

Experiments (tests of all of the above)

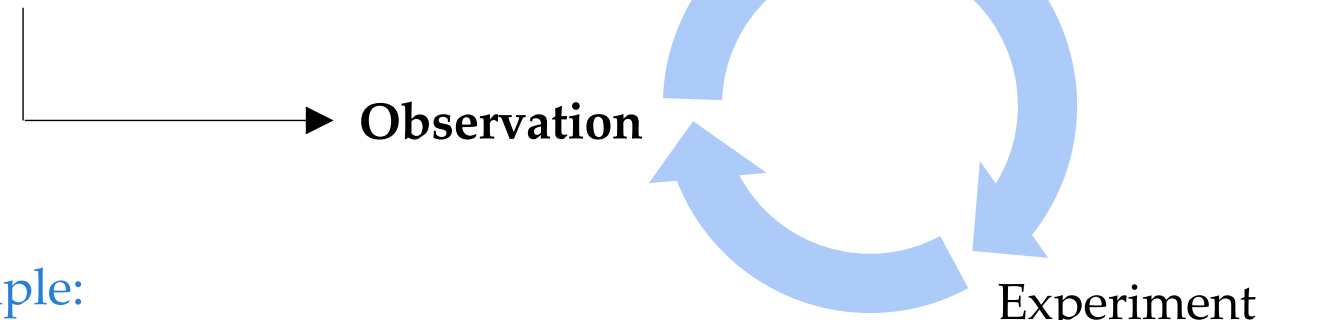
Characterizations (observations, definitions, and measurements of the subject of inquiry)



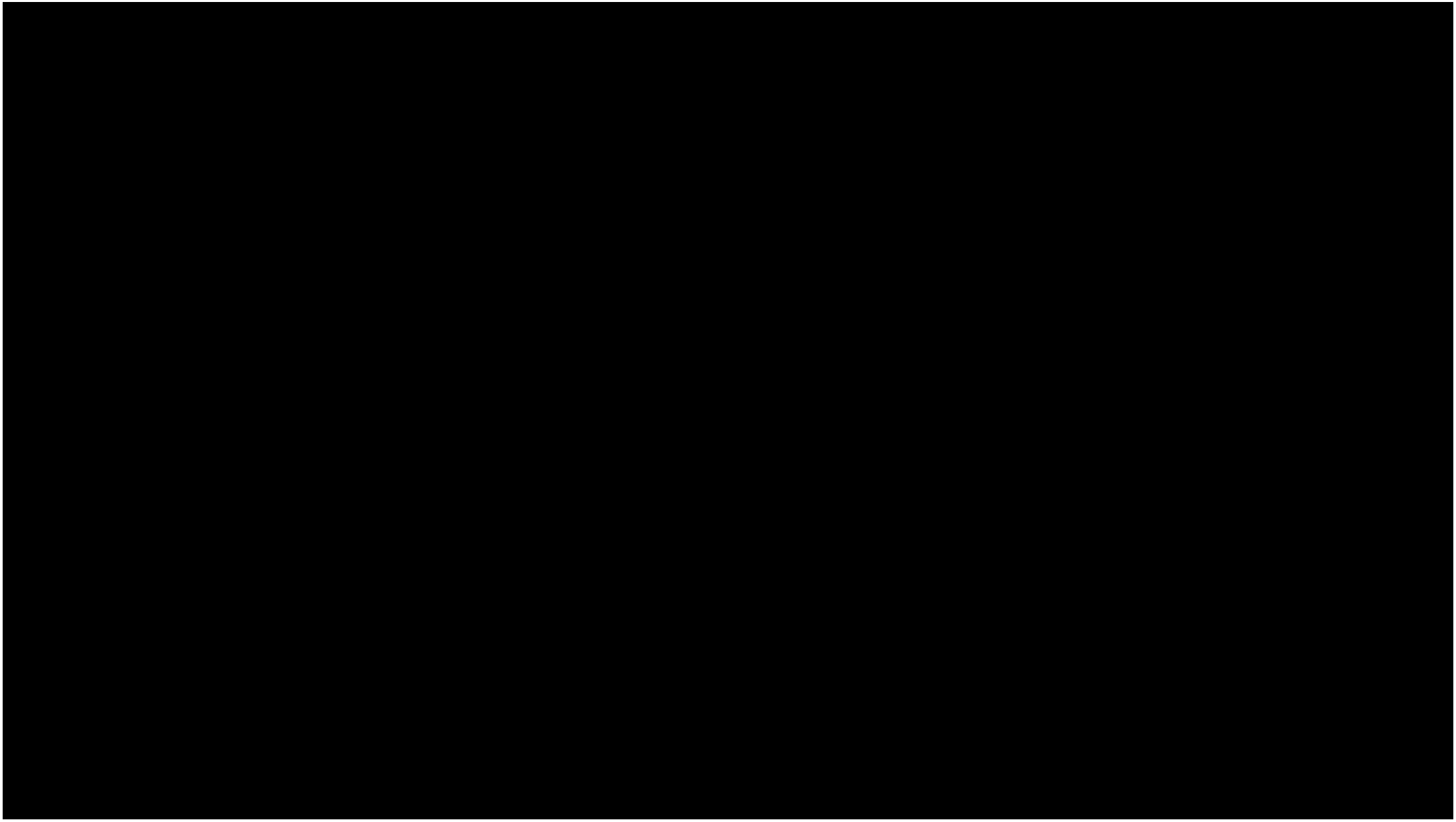
Elements of the scientific method
(from Wikipedia.org, "Scientific method")


Research question &
hypothesis
Observation
Experiment

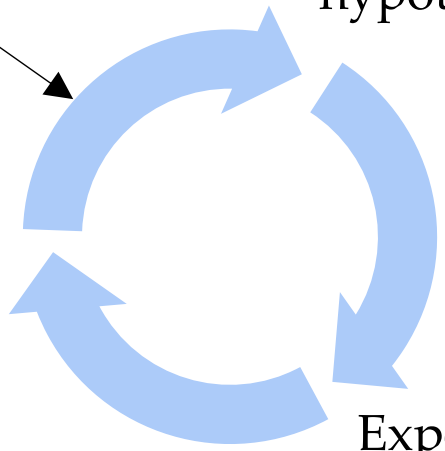
It often starts with a casual or informal observation (phenomenon, problem, existing research, …) and a related idea



Example:
Rubber hand experience



Search for related work
to examine the field,
identify lacks in
the state of the art, …



Idea: can we take advantage of this in VR and create "unreal" experiences that feel real?
(E.g., long arms, third arm, etc.)

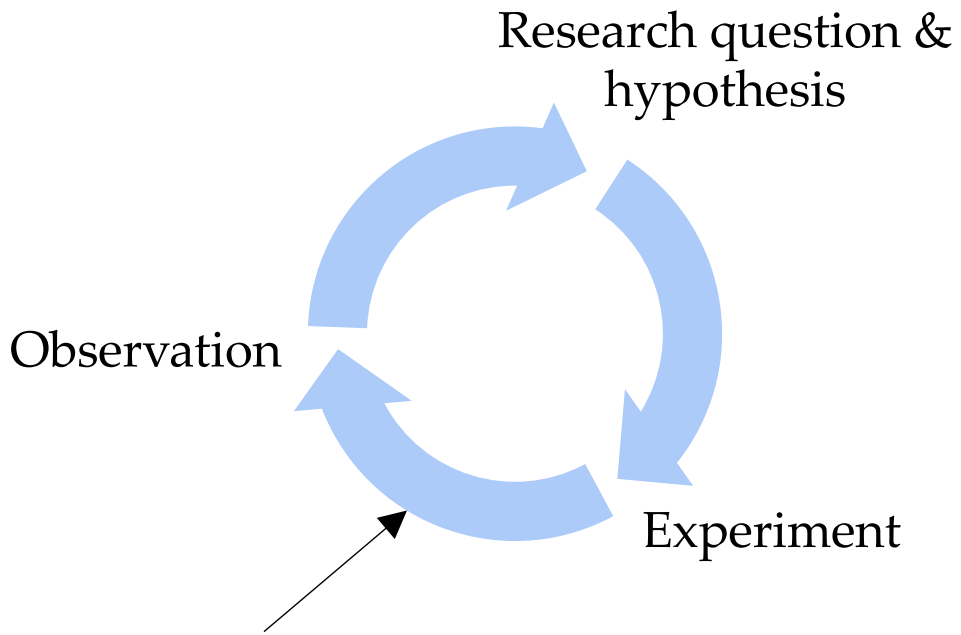
C. Gilbers: "The Sense of Embodiment in Augmented Reality:
Inducing a Third Arm Illusion with Multimodal Feedback" (MSc thesis)

The Sense of Embodiment in Augmented Reality

INDUCING A THIRD ARM ILLUSION WITH MULTIMODAL FEEDBACK

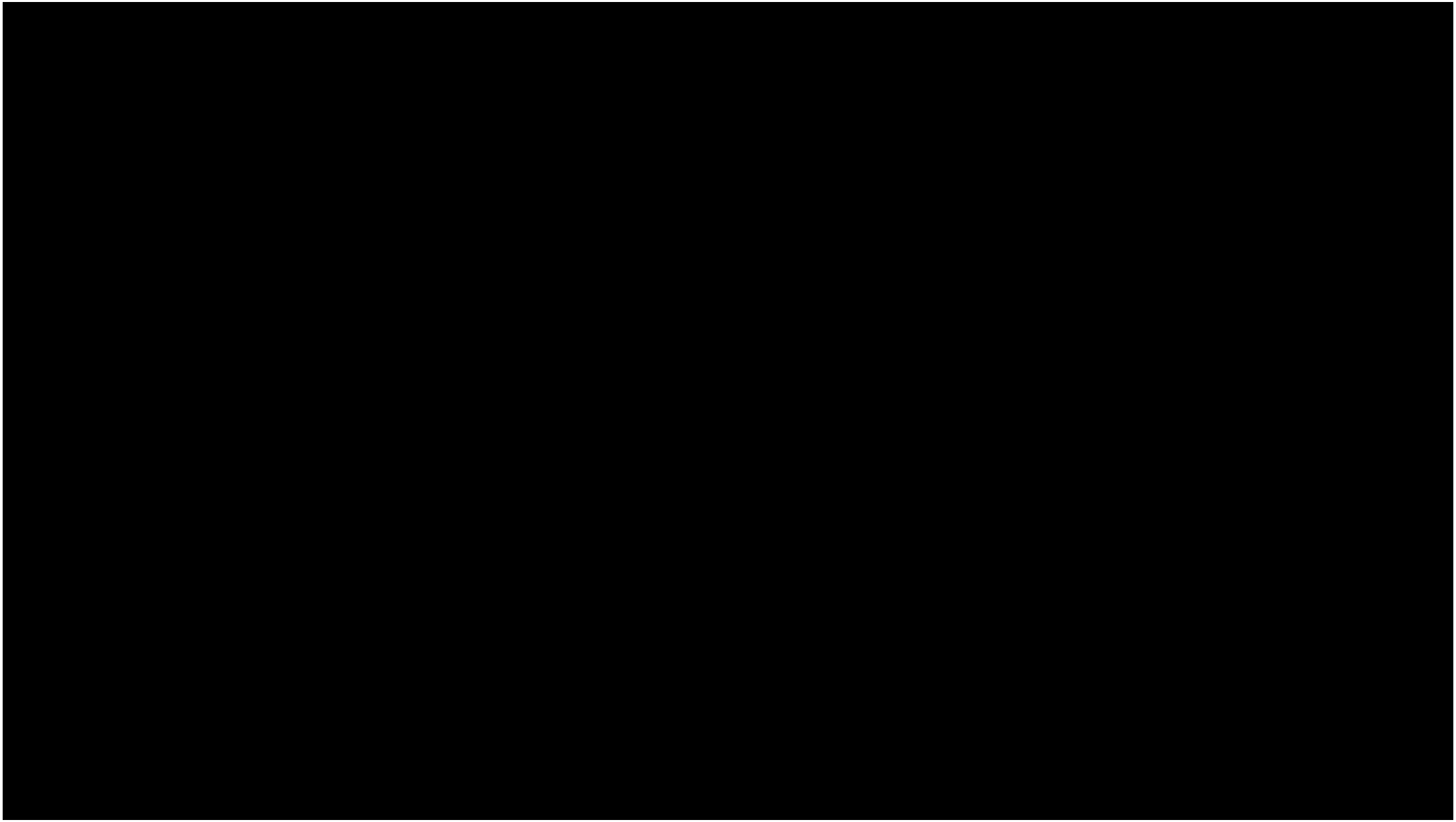
Carolien Gilbers

https://www.projects.science.uu.nl/cs-gmt/index.php?r=project/view&id=57

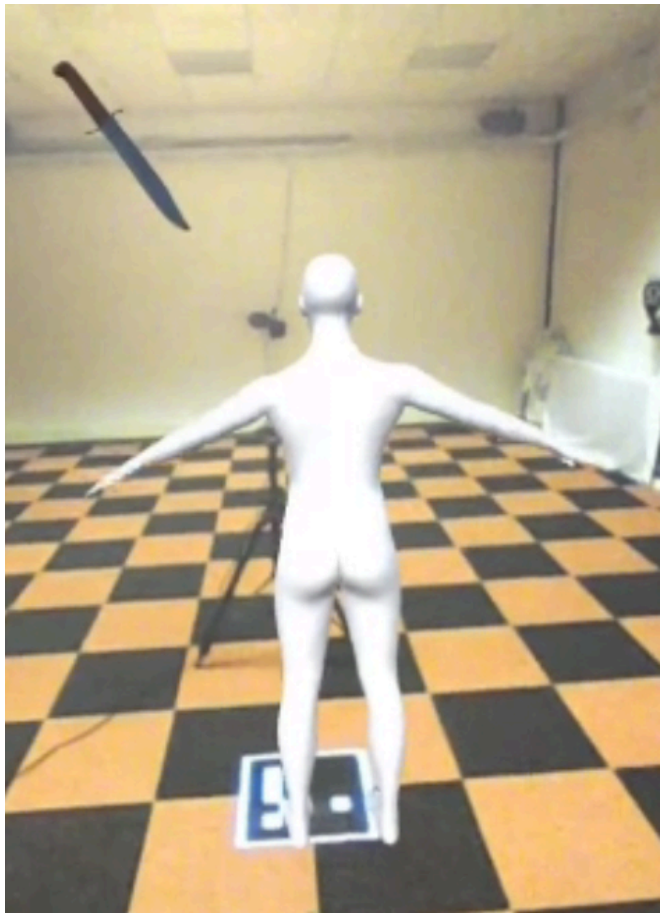


Note that unexpected observations and results
caused us to reconsider and modify
our research question and experiment

J.-P. van Bommel: “Presence and Embodiment in Augmented Reality” (MSc thesis)



https://www.projects.science.uu.nl/cs-gmt/index.php?r=project/view&id=71



Note that stabbing someone with a knife
(even just virtual characters)
has ethical implications
that need to be considered
in the experiment design.

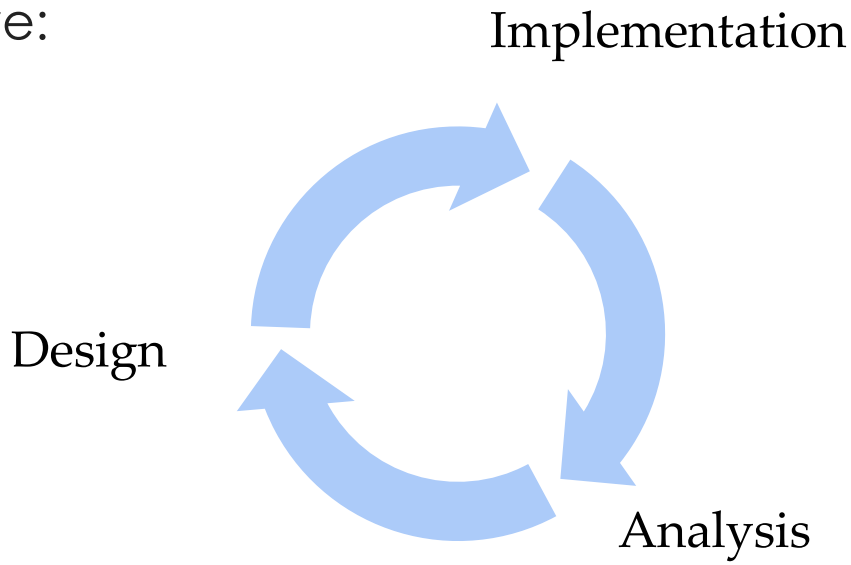
We will talk more about
ethics and scientific integrity
throughout this course.

	Mathematical method	Scientific method
1	Understanding	Characterization from experience and observation
2	Analysis	Hypothesis: a proposed explanation
3	Synthesis	Deduction: prediction from the hypothesis
4	Review/Extend	Test and experiment

From Wikipedia.org, "Scientific method"

Notice the similarity. In **theoretical computer science**, we also often use mathematical methods.

Applied research follows a similar approach, **e.g. in HCI**, we often have:



But how is this different than "just" implementing and testing?
Because the analysis follows scientific guidelines,
so we are not just testing a concrete implementation but its characteristics.

Various methods are used.

What qualifies as scientific?

What are the unique, identifying characteristics of scientific research?

Scientific research involves using the scientific method, which seeks to objectively explain the events of nature in a reproducible way.

From Wikipedia.org ("Science")

Top 9 Main Characteristics of Science:

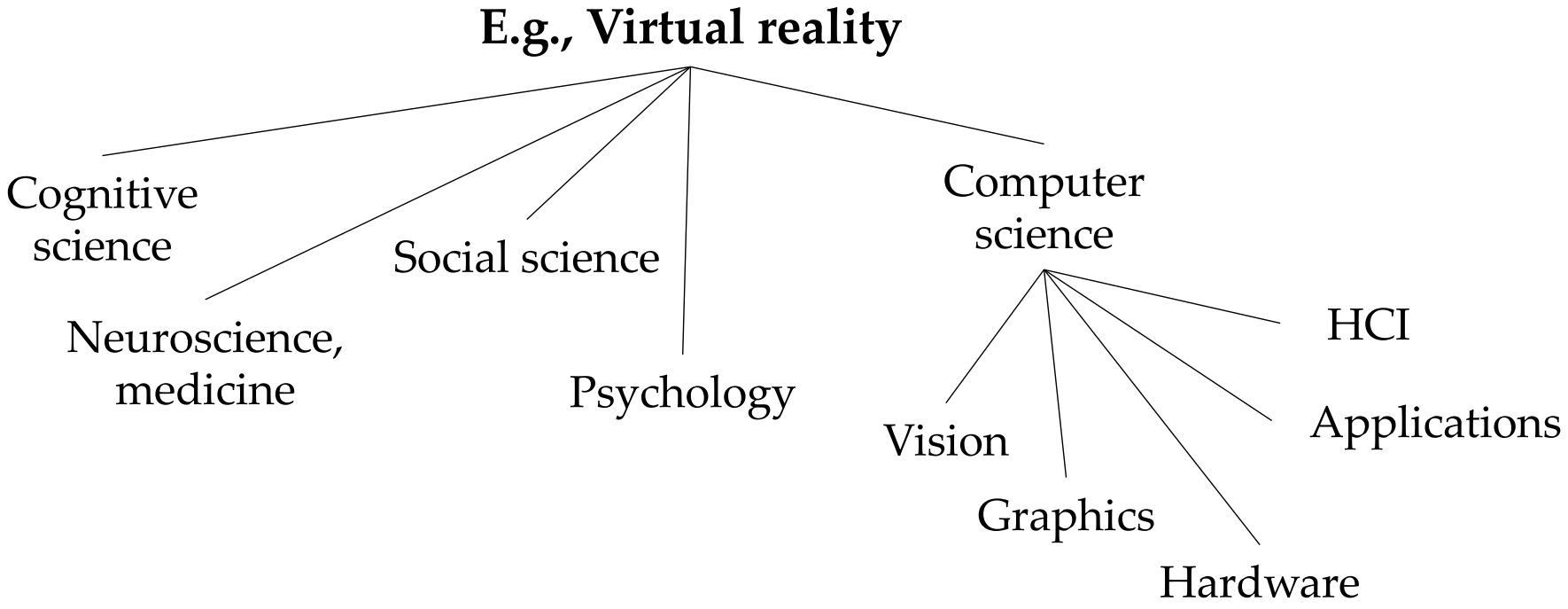
1. Objectivity
2. Verifiability
3. Ethical Neutrality
4. Systematic Exploration
5. Reliability
6. Precision
7. Accuracy
8. Abstractness
9. Predictability

Source: http://www.yourarticlelibrary.com/science/top-9-main-characteristics-of-science-explained/35060

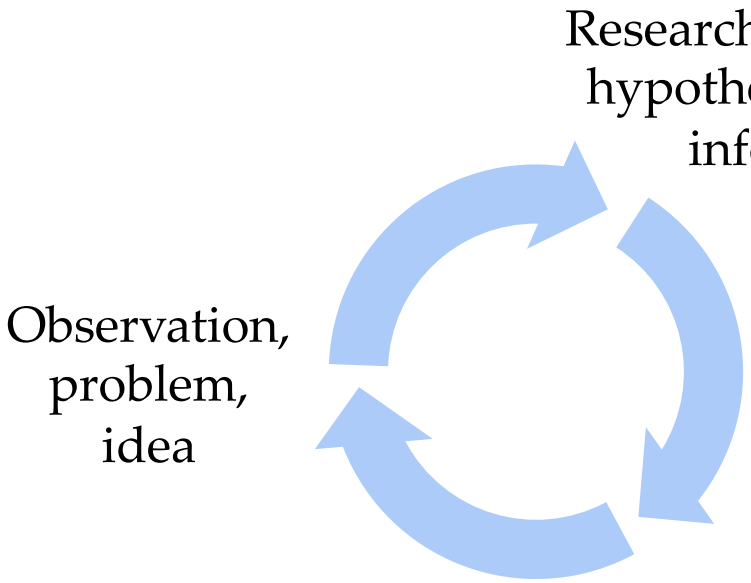
What methods are characteristic for GMT?
Or computer science?

There is no clear answer to these questions.

Computer science in itself is a very diverse field.
And it "borrows" various input and methods from others.



In GMT, mostly:



- Fundamental research
- Experimental research
- User studies
- Other (design, engineering, systems)

Fundamental research:

Not related to specific data, nor to users.

Provides answers to universal questions within well-known and well-accepted scientific frameworks.

Experimental research:

Done on a data set that can come from the real world (by measurements) or that may be generated (synthetic data).

Answers to questions cannot be universal: whatever is observed is observed for the tested data only, and not for all conceivable data.

The research question itself can be a theoretical question or an applied question.

User study research:

Studies or observes humans and their behavior.

Can also be rather fundamental or more applied.

In all cases, answers to user study research questions tell us something about users, and not about (non-user) data or abstract frameworks.

Remember the earlier slide on "branches of science" >>

The **branches of science**, also referred to as sciences, "scientific fields", or "scientific disciplines," are commonly divided into three major groups:

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⇒ Fundamental research

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Social sciences: the study of human behavior and societies.")
⇒ User study research

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In this course,
we will mostly cover:

- Fundamental research *(Marc)*
- Experimental research *(Marc & Wolfgang)*
- User studies *(Wolfgang)*

And some other, e.g.,
systems & design research *(Wolfgang.)*

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End of the introduction.

Take home messages:

- *Science is about generating knowledge*
- *Different scientific domains have different methods*
- *They all share common characteristics*
- *Computer science uses a mixture of them*
- *We will address the most relevant for GMT in this course*

Any questions, comments, …?