

Some remarks on

Research

&

Writing a research paper

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Different research targets

- A research question
 - there are some facts you don't know....
 - and want to find out
- A problem
 - you want to find a solution to some problem
- A theory or description
 - you are searching for a point of view....
 -to understand and explain some part of reality....
 -that fits the facts satisfactorily
- A system to be designed
 - you are searching for a good –or the best- design....
 -and you need alternatives, and arguments
- These are not exclusive!

From the presentations

- Shervin and Sachin
 - How to model the quality constraints?
 - energy, reliability,
 - How to approach the suggested optimization problem?
 - model the problem and find solutions
 - make tradeoffs explicit
 - which theory is applicable here?
 - What principles are general?
 - geographic properties, in-node processing, dynamic routing...
 - can we show their benefits in a real system?
 - can we understand the requirements this would put on the nodes?
 - What concepts can be re-used?

Presentations

- Norbert and Ashu
 - What are relationship between sketched models and design decisions of equipment
 - examples, models and measurements
 - What are common practical solutions, and properties?
 - Are there good models to trade communication for computation (encoding?)
 - what is the practical feedback on this topic?
 - can we develop those?
 - can this be intertwined with the application? i.e., can we use application knowledge to improve the encoding? does this make any sense at all?

Presentations

- Chidi and Bram
 - Is the problem really one of mutual exclusion?
 - Which issues are fundamental and which are just limitations from current technology?
 - Given this overview can we now build the definitive protocol which optimizes the metrics?
 - Are there definitive arguments, simulations, implementations, models, for the difference centralized/distributed/hybrid?
 - Are there insights with respect to scalability? What scales with what?
 - What are bottom-line figures?
 - How can we understand the tradeoff so that decisions can be made for a given application; What is traded for what?
 - What are application requirements for a MAC (local and global)?
 - What is the effect (on metrics) of a wake-up radio?

Order in research activities

- Put in the right order:
 - research, read literature, write paper, choose topic, state questions, related work
 - choose topic; write paper; research; state questions
 - the paper will structure the research and will help to get the questions clear
 - state questions; read literature
 - the questions will structure and select the literature
 - related work goes to the end of your paper
 - so *your ideas* become first class citizens
 - and you do not discuss issues that cannot be understood yet
 - however, be absolutely truthful to existing work
 - put effort in finding, understanding, summarizing and valueing it
 - acknowledge work of others

Method: literature

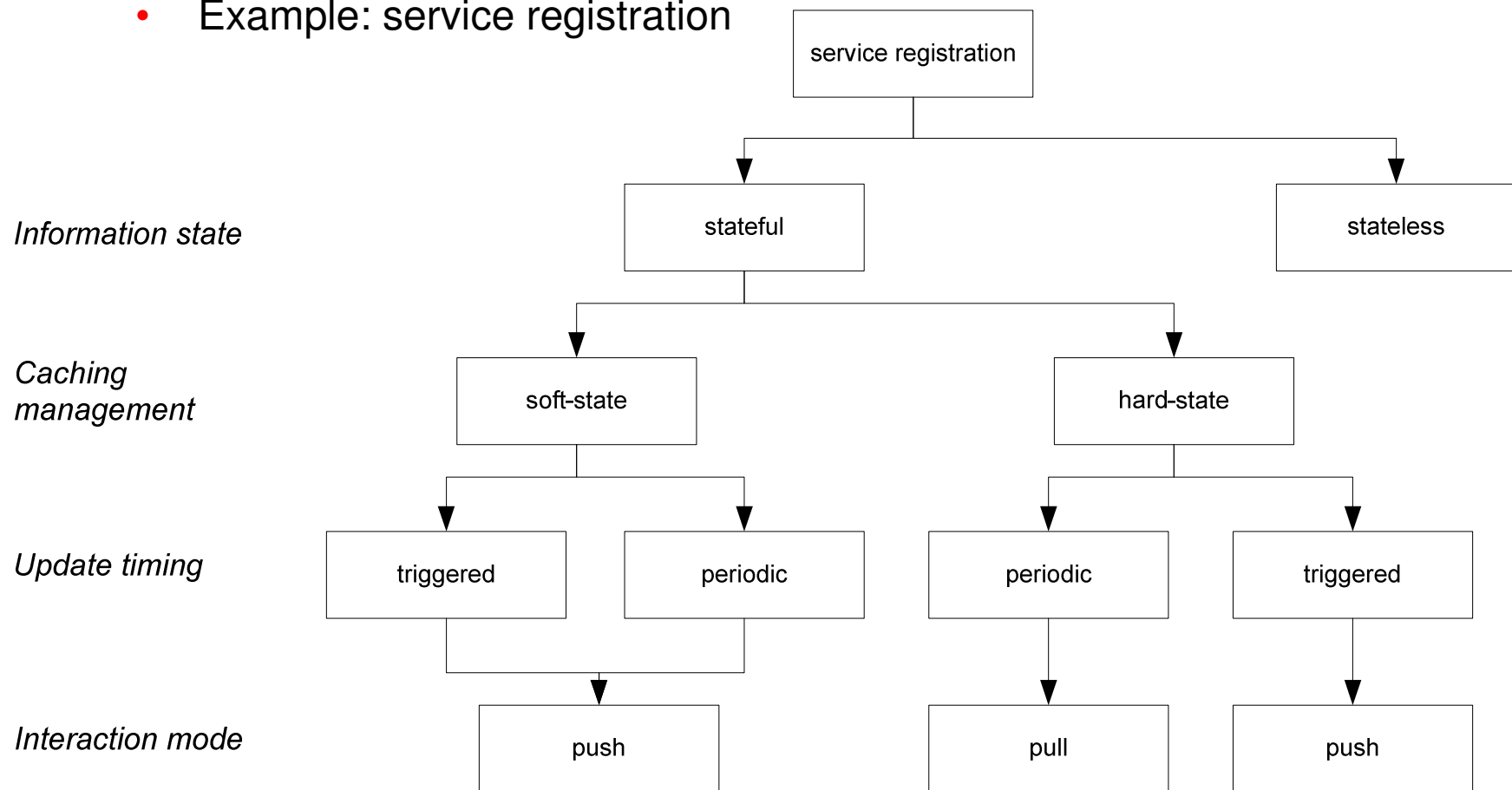
- journals
 - select *high-impact* journals (for CS: IEEE, ACM)
 - aim for *original* articles (the first ones to set a direction)
- conferences
 - go to IEEE and ACM sites
 - examine relevant proceedings of the last two years
 - this teaches you what is *hot* and *new* in that field
 - you find references to *original* articles
- *know what you want to know – so you can skip what you don't need*
 - e.g., if you want to understand the methods computer scientist use to analyse protocols, you focus on the method section

Method: taxonomy

- Find *criteria* that dissect the domain of discourse
 - independent, if possible
 - hierarchical
- Organize the domain as a tree structure of labelled choices
- Investigate where reported (literature!) solutions and systems fit
- Observe empty spots: possibilities for new systems, methods
- Find metrics to discriminate the choices

Example: taxonomy for service registration

- Example: service registration



Method: experiments

- Use *hypotheses* you want to test
 - e.g. the performance is linearly dependent on the latency
 - e.g. the use of *gnath* makes people more *glub*
- Design experiments accordingly
 - e.g. make it possible to have several different latencies
- Fully execute and record the experiment
 - do not change the experiment halfway, do not deviate from the planOnly then review the new situation and design new hypotheses
- Try to overlook the whole system; see whether the answer can be given in a much simpler way
 - e.g., a direct argument, an analytical solution
- Make sure you or someone else can *reproduce* experiments
 - describe your experiments truthfully and completely
- Cover the parameter space

Method: metrics

- If you need to balance trade-offs...
 - as, e.g., in designs
-use *metrics* to
 - define importance
 - allow comparison
- metric:
 - mapping of a system (property or asset) into the real numbers
- Typically a total cost function (a *value function*) is given as the inner product of a weight vector and a vector of metrics
- Example metrics: latency and throughput, cost (money), energy, response time

Method: modeling

- Find the relevant *concepts* and their *relationships*
 - often, this *is* the problem description
- Abstract from irrelevant details
 - motivate what you leave out
 - model with respect to *goals* you set out first
- Quantitative models: compute or simulate
 - e.g. the simulation of a CSMA protocol
- Validate (and think about that in advance)
 - compare with experiments with the real system
 - find consistency arguments

Method: Interview

- Find experts to obtain their knowledge
 - motivate for yourself the particular choice
 - why do I talk to this guy?
 - write down for yourself what you want to know of him
 - prepare questions!
- Separate facts and viewpoints!
 - try to see this interview as an experiment

Writing about a *system*

- What's the difference between
 - a research paper
 - the essential choices motivated
 - these last longer than the system
 - the essential concepts explained
 - these last longer than the system
 - trying to find quality *metrics*
 - focus: teaching a longer-lasting principle
 - focus: allowing to judge quality, and to compare
 - and a manual?
 - how does the system work?
 - how do I use it?

How to learn?

- Do it!
 - it's **you** (and not the teacher) that wants to answer questions, find out facts, solve problems, etc.
 - expose yourself to critique, and improve
- Get on the internet
 - with the phrase 'writing a research paper', or something alike
 - take the advice seriously
- good stuff in e.g.:
 - <http://research.microsoft.com/~simonpj/papers/giving-a-talk/writing-a-paper-slides.pdf>
- The purpose of a paper is
 - to convey your ideas and findings....
 - as clear as possible
 - and objectively

Title & Author Information:

briefly summarizes the subject or purpose of the article & documents the author's credentials in the field of study

Abstract:

summarizes the research study and results of the study

Introduction:

states the hypothesis or purpose of the research

Review of Literature:

summarizes previous research or what has already been written on the subject

Methodology:

describes what kind(s) of research methods were used in this project and how the study or survey were constructed and implemented

Findings/Results:

collates and summarizes the data collected and calculates totals or trends

Conclusions/Discussion:

discusses applications or implications of the findings/results

Further Study:

suggests areas where more complete data or findings are needed and related areas for future research

Works Cited/References:

lists the sources cited by the author(s) of the article

<http://www.nwmissouri.edu/library/courses/hes/resart.htm>

Connie Ury and Carolyn Johnson

Introduction

- Typical introduction:
 - *broad view explaining relevance / context of paper*
 - *narrowing towards the paper subject while discussing contributions by other authors*
 - *naturally ending in a explanation of the paper's subject*
 - hypothesis, problem statement,
 - *concluding with a brief overview of the paper*
 - that logically fits the given introduction
 - and touches upon the method used

Style

- Although you may not like it....
 - write as objectively as possible: use ‘we’ rather than ‘I’, avoid addressing the reader and try to let the matter speak for itself.
 - I rewrite this as ...
 - We rewrite this as ...
 - This is rewritten as ...

 - As the reader can observe ...
 - As you can observe
 - As can be observed ...
- Avoid superfluous wording
- Check an IEEE style for LateX or Word
- Check reference styles:
 - according to Jan et al.[4], according to [4], [Jan2003]

Conclusion

- Revisit the issue posed in the introduction
 - systematically address it
 - and list your contributions