Introduction to Research
(in Data Management)

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What is research about?

- We solve unsolved problems
  - Unsolved not unsolvable

- Examples:
  - How to fly faster?
  - How to cure cancer?
  - How to enable a machine to see?
  - How to understand all data generated by human?

- Research is about finding solutions for unsolved problems in different life aspects
  - Health, engineering, behavioral sciences…etc
Is research that big?

- It is,
  - but many MANY teams contribute to that big problems

- Example: how to enable a machine to see?
  Subproblems:
  - How a human see?
  - How to make an artificial eye?
    - How to take photos? (Camera) - How to make it better? .....etc
  - How to make an artificial vision brain?
    - How to segment photos? - How to know objects? .....etc
  - How to connect eye to brain?
  - How to ............
Is research that big?

- It is a big puzzle
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Research problem elements

To address a research problem, answer six questions:

1. What is the problem?
2. Why it is important?
3. Why it is challenging?
4. What are the limitations of the related work?
5. What are the novel contributions?
6. What is the validation method?
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Computational problem definitions:

- What is the input?
- What is the output?
- What are the objectives/constraints?
- Any other contextual elements for problem definition
Research problem elements

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Research problem elements

To address a research problem, answer six questions:

2. Why is it important?

Getting a square elephant into a circle door is a problem, but not an important one.
Research problem elements

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2. Why is it important?
3. Why is it challenging?
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Research problem elements

To address a research problem, answer six questions:

2. Why is it challenging?

   calculating $x*y$ is an important problem to solve, but it is not difficult, and it can be handled by hardware in $O(1)$
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Research problem elements

To address a research problem, answer six questions:

4. What are the limitations of the related work?

Given: a point location, 100 millions spatial objects

Find: the nearest neighbor

Important and challenging! but solved before, why existing solutions do not work.
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Research is about novel contributions to advance existing knowledge.
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Introduction to Data Management Research
The digital world

- Data sources:
  - Business: retailers, enterprise, etc
  - Humans: games, social media, crowdsourcing, etc
  - Science: astronomy, biology, satellites, etc
  - ....

- 199x: Internet services provided to public

- 200x: Internet comes to mobile devices (revolution)

- Now: ?
Startups Using Big Data

Cybersecurity
- CounterTack
- RISKIQ
- CLICK Security

Marketing
- custora
- CROWDSTRIKE
- Lytics
- Rapid7
- Sense
- Localytics

Real Estate
- REONYX
- homesnap
- Agent Ace
- COMPSTAK

Agriculture
- FarmLogs
- Farmeron
- AgSquared
- mavrx

Healthcare
- Granular
- Tonic
- HealthCatalyst
- SolveBio

Supply Chain
- fusionops
- stitchlabs

Retail
- Mu Sigma
- LogiNext
- Capillary
- Prayas Analytics

Energy
- bidgely
- stem

Science
- AutoGrid
- Retroficiency

Finance
- wegowise
- plotwatt
- OpenGamma
- Kreditech

HR/Recruiting
- VoloMetrix
- objective logistics

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Internet services provided to public

Internet comes to mobile devices (revolution)

Now?
Data is the new Oil

The Economist

The world’s most valuable resource is no longer oil, but data

The data economy demands a new approach to antitrust rules

FORTUNE

Why Data Is The New Oil

Jonathan Vanian
Jul 11, 2016

Forbes

Is Data The New Oil?

Tech
APR 2, 2012 @ 11:09 AM
“Data is just like crude. It’s valuable, but if unrefined it cannot really be used.”

Michael Palmer
Oil Refinery vs. Data Refinery

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Here's Why Data Is Not The New Oil

Bernard Marr  Contributor
Enterprise & Cloud

No, Data Is Not the New Oil

Proposals to "pay" users for the value of their data don't reflect how internet giants like Facebook and Google really operate.

Data is not the new oil

About the reality of working with data
Oil Refinery vs. Data Refinery

- Why data might not be the new oil?
  - Oil refinery is much more deterministic (easier?)
  - Oil is finite, data is not
Oil Refinery vs. Data Refinery

Why data might not be the new oil?

- Oil refinery is much more deterministic (easier?)
- Oil is finite, data is not

Earth / Population

7.53 billion (2017)
Stages and Activities

- **Stages:**
  - Identifying a problem
  - Proposing a solution
  - Realizing and validating the solution
  - Documenting the research (writing papers)

- **Activities:**
  1. **Reading:** existing work, prior knowledge,…etc
  2. **Coding:** your solution, related work, utilities,…etc
  3. **Writing:** papers, summaries,…etc
  4. **Presenting:** your problem, solution, surveys, etc