How to find innovative ideas for your project

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Frequent questions

- Is my idea a good one?

- How to find a good idea?

Criteria of “good work” (in reviewers’ eyes)

1. Novel

2. Convincing

Criteria of "good work" (in reviewers' eyes)

1. Novel
   - *Bored reviewers want surprise!*
   - *Has anyone done similar things before you?*

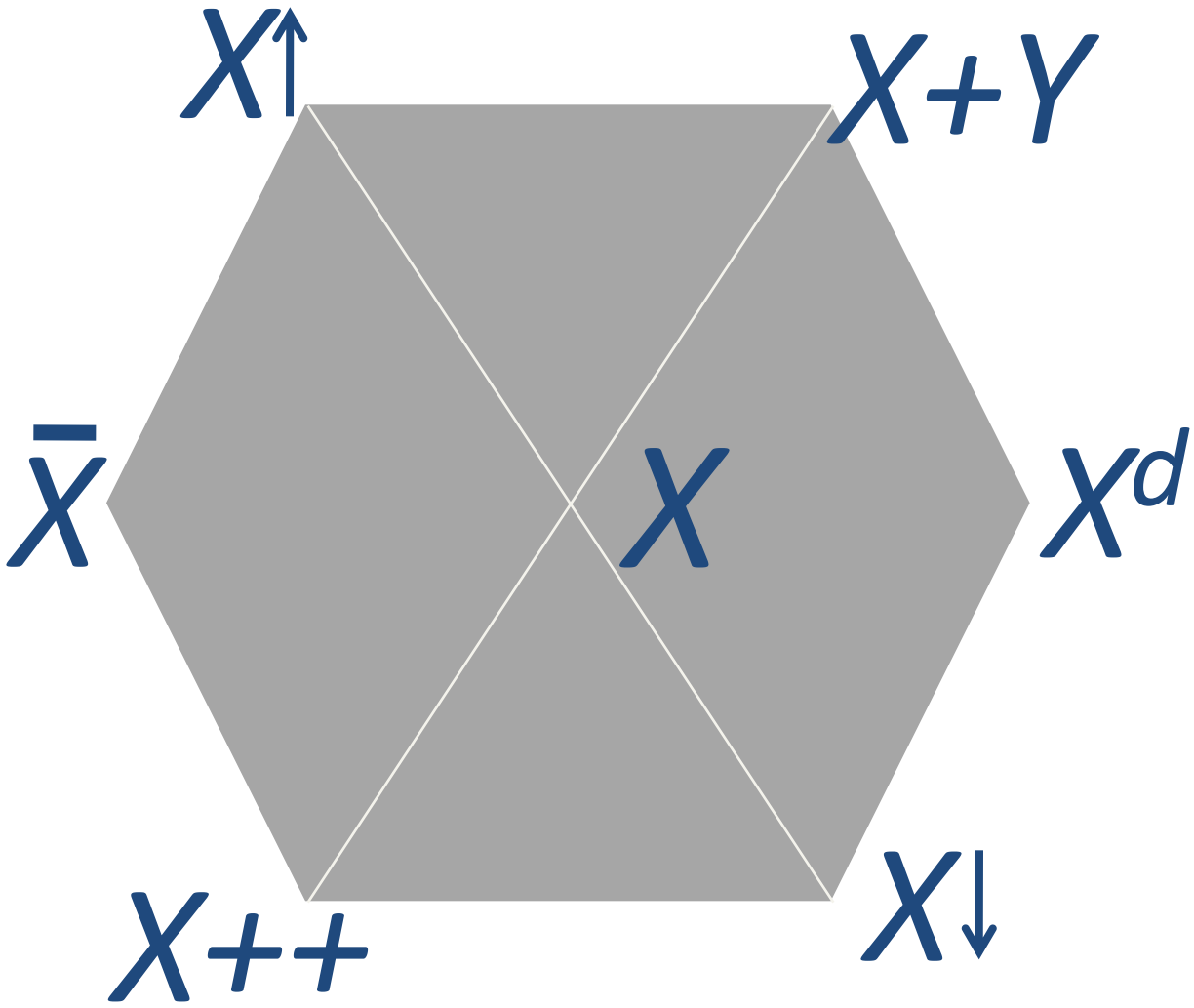
2. Convincing
   - *Reviewers are suspicious.*
   - *Reviewers want convincing insights and solid experiments (or solid math proof).*

Smell of risk ideas

- Do something you are not excited or interested
  - *Quickly you will find your time is wasted.*
- Do it because it can be done
  - *Where is the "impossible"?*
- Overlook the previous literature
  - *Where is the innovation?*
- Very complicated pipeline at your first try
  - *Some pieces may easily fall down.*

Ramesh Raskar's Innovation Hexagon

Six ways of coming up with new ideas based on an idea 'X'.



What are good candidates of “X”s

- Successful applications or algorithms

- (Very) recently developed

  or

- Has been there for long but overlooked

Brainstorm list of good "X"s

Try to name 3+ by discussing with the students next to you

- Successful applications
  - Translation
  - Speech2text
  - Face recognition
  - Question answering
  - …

My list is strongly biased but hopefully could give you some idea

- Recent cool algorithm
  - Bach (re)normalization
  - Residual network …
  - Generative Adversarial Networks (GAN) and Wasserstein GAN
  - Fast text
  - SqueezeNet
  - Distilling
  - Curriculum learning

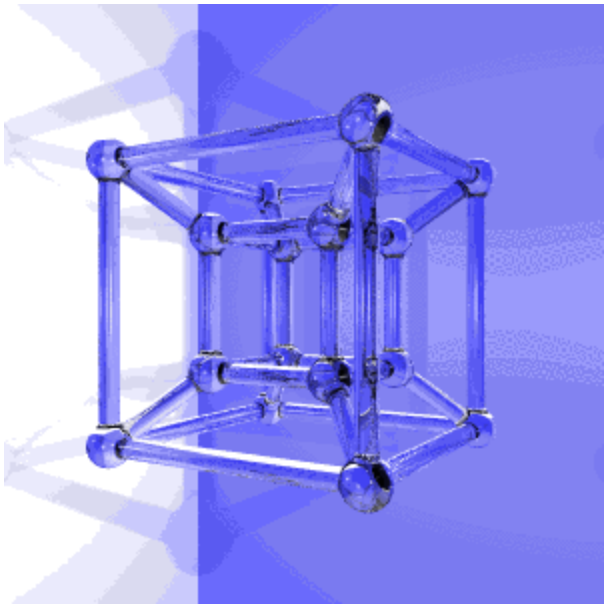
Examples of innovation hexagon

Note a lot of following slides are courtesy to Ramesh Raskar

I only add some examples of deep learning research.

Strategy #1: X^d

- Extend it to next dimension (or some other) dimension
  - Flickr to Youtube
  - Images to infrared, sound, ultrasound to EM spectrum



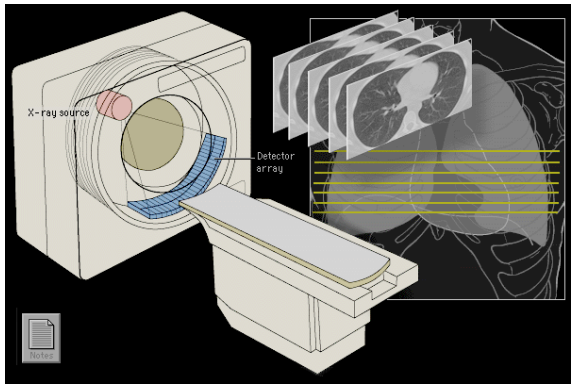
- Example in deep learning

  Image based question answering

  => Album/video based QA

Strategy #2: X+Y

- Fusion of the dissimilar
  - More dissimilar, more spectacular the output
- Example
  - Scientific imaging + Photography
    - Coded aperture
    - Tomography
- Keys
  - Deep insights on why X + Y
  - The connection should be a surprise!
- Example of surprise:
  - Visually indicated sound



Strategy #3: $\overline{X}$
Do exactly the opposite

Bundesarchiv, Bild 183-S0305-0030
Foto: Mittelstädt, Rainer | 5. März 1977

Straddle Method for High Jump

Replacement of landing surfaces with foam rubber

http://en.wikipedia.org/wiki/Dick_Fosbury

Strategy #3: $\bar{x}$
Do exactly the opposite

- From LSTM to word2vec
  - LSTM: long context and deep model
  - Word2vec: small window and shallow network

  Word2vec works well for word embedding!

- From Faster R-CNN to YOLO/SSD
  - Faster R-CNN: object proposal as regions and then detect
  - YOLO/SSD: predict the bounding box simultaneously with detecting

  YOLO/SSD are faster!

Strategy #4: X ↑

- Given a Hammer ..
  - Find all the nails
  - Sometimes even screws and bolts
- Given a cool solution/technique/Opportunity
  - Find other problems

- Examples
  - CNN was first developed for vision
    - Now it has been used for speech and text classification

Strategy #5: X ↓

- Given a nail,
  - Find all hammers
  - Sometimes even screwdrivers and pliers may work
- Discover a problem,
  - Find possible solutions

- Examples
  - AlphaGo

Strategy #6: X++

- Pick an adjective:

neXt = adjective + X

Examples:

- Faster: e.g., R-CNN -> Fast R-CNN -> Faster R-CNN
- Cheaper: e.g., AlexNet -> Squeeze Net
- More efficient: e.g., Distilled learning
- …

Pitfalls

- These six ways are only a start
- They are good for projects which help you start your research career
- But
  - Significant innovations may not share a pattern
  - The risk of following patterns exists by creating a problem which does not exist in real
- The important thing is to develop your own deep insights
    - What is the true challenge?
    - How are you going to solve it?