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
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.
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
  - …

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

My list is strongly biased but hopefully could give you some idea
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
  $\Rightarrow$ 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: \( \boxed{X} \)

Do exactly the opposite

Replacement of landing surfaces with foam rubber


**Straddle Method for High Jump**
Strategy #3: 

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:  

- 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:  

- 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:

\[ \text{neXt} = \text{adjective } + \text{ X} \]

Examples:
• Faster: e.g., R-CNN \rightarrow Fast R-CNN \rightarrow Faster R-CNN
• Cheaper: e.g., AlexNet \rightarrow 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?