

2018년 한국정보처리학회 추계학술발표대회

Understanding Complex Systems with Data and Network Science

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Brief Bio

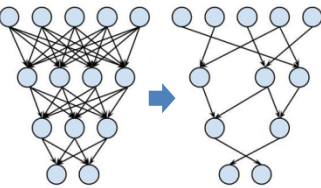
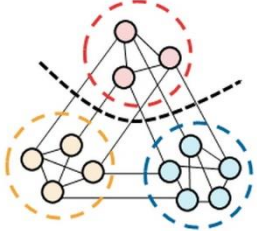
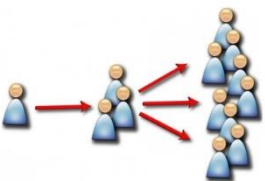
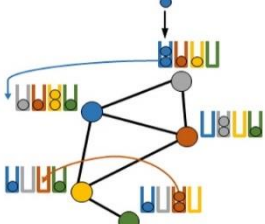
● Research Interests

Mining and modeling large-scale complex networks to study their structural properties (e.g., identifying community structure) and dynamical behaviors (e.g., analyzing information diffusion)

● Research Experience

Assistant Professor	Data Intelligence Lab. Dept. of Computer Science and Engineering, CNU	2018~now
Ph.D.	Data Mining Lab. (Advisor: Prof. Jae-Gil Lee) Graduate School of Knowledge Service Eng., KAIST	2011~2016
Researcher	Machine Intelligence Lab. (Advisor: Prof. Kyomin Jung) School of Computing, KAIST	2010~2013
B.S./M.S.	Statistical Inference Lab. (Advisor: Prof. Sung-Ho Kim) Dept. of Mathematical Sciences, KAIST	2004~2011

Research Projects

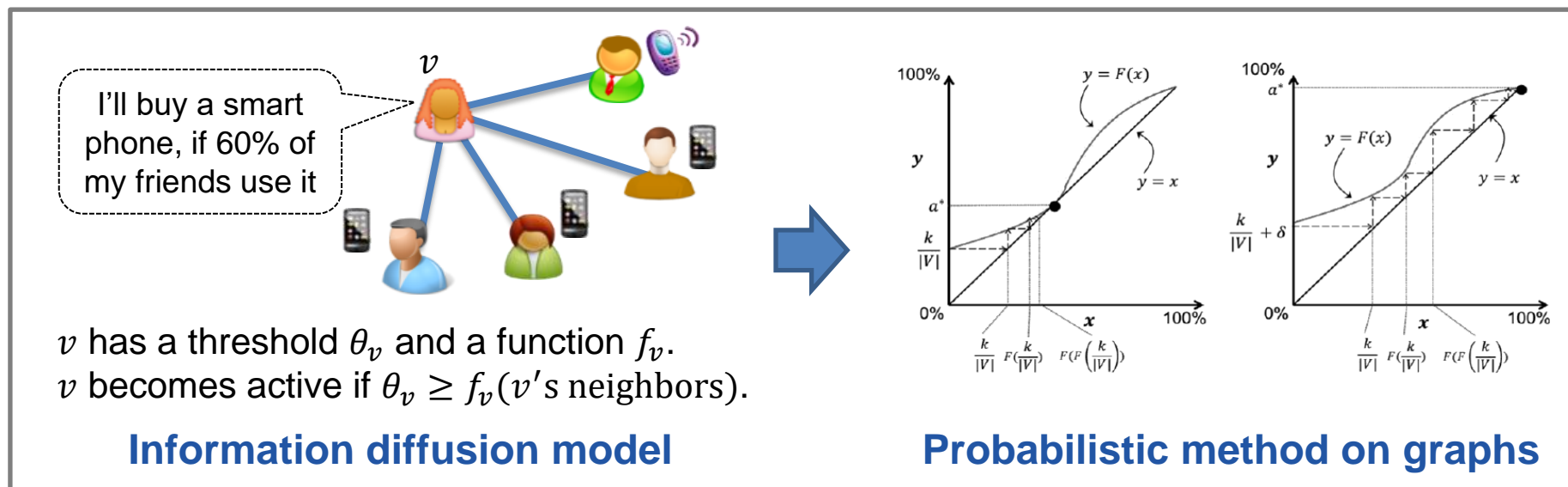
	<p>Graph Compression, Privacy-Preserving Data Analysis (2018-Present)</p> <ul style="list-style-type: none">- Principal Investigator / Joint work with NOTA Inc., Ajou Univ.- Developing efficient learning algorithms for deep neural networks- Designing algorithms for network data guaranteeing differential privacy
	<p>Structure of Networks (2013-Present)</p> <ul style="list-style-type: none">- Advisor: J.-G. Lee- Detecting community structure in social networks- Publications: Ph.D. thesis, 2 top-tier conferences, 3 SCI journals, 1 preprint- Awards: Qualcomm Innovation Award (2016), kt Big Contest Award (2014)
	<p>Dynamics on Networks (2011-2013)</p> <ul style="list-style-type: none">- Advisor: K. Jung / Collaborator: J.C.S. Lui (CUHK)- Analyzing information diffusion in complex networks- Publications: 2 SCI journals, 1 preprint- Award: Microsoft Research Asia Fellowship Nomination Award (2012)
	<p>Communication Networks (2010-2012)</p> <ul style="list-style-type: none">- Advisor: K. Jung / Collaborator: M. Andrews (Nokia Bell Labs)- Studying the stability of routing in wireless networks- Publications: 1 top-tier conference, 1 SCI journal- Award: Samsung Humantech Paper Award (2012)

Selected Publications

1. J. Kim et al., “LinkBlackHole*: Robust Overlapping Community Detection Using Link Embedding,” accepted to IEEE TKDE (**SCI**)
2. J. Kim et al., “Differential Flattening: A Novel Framework for Community Detection in Multi-Layer Graphs,” ACM TIST, 2017 (**SCIE**)
3. S. Lim and J.-G. Lee, “Motif-Based Embedding for Graph Clustering,” JSTAT, 2016 (**SCIE**)
4. S. Lim et al., “BlackHole: Robust Community Detection Inspired by Graph Drawing,” IEEE ICDE, 2016 (**BK21+**)
5. S. Lim et al., “Phase Transition for Information Diffusion in Random Clustered Networks,” EPJ B, 2016 (**SCI**)
6. S. Lim et al., “Analysis of Information Diffusion for Threshold Models on Arbitrary Networks,” EPJ B, 2015 (**SCI**)
7. S. Lim et al., “Stability of the Max-Weight Protocol in Adversarial Wireless Networks,” IEEE/ACM TON, 2014 (**SCI**)
8. S. Lim et al., “LinkSCAN*: Overlapping Community Detection Using the Link-Space Transformation,” IEEE ICDE, 2014 (**BK21+**)

Highlight 1: Information Diffusion [EPJB 15, 16, Preprint]

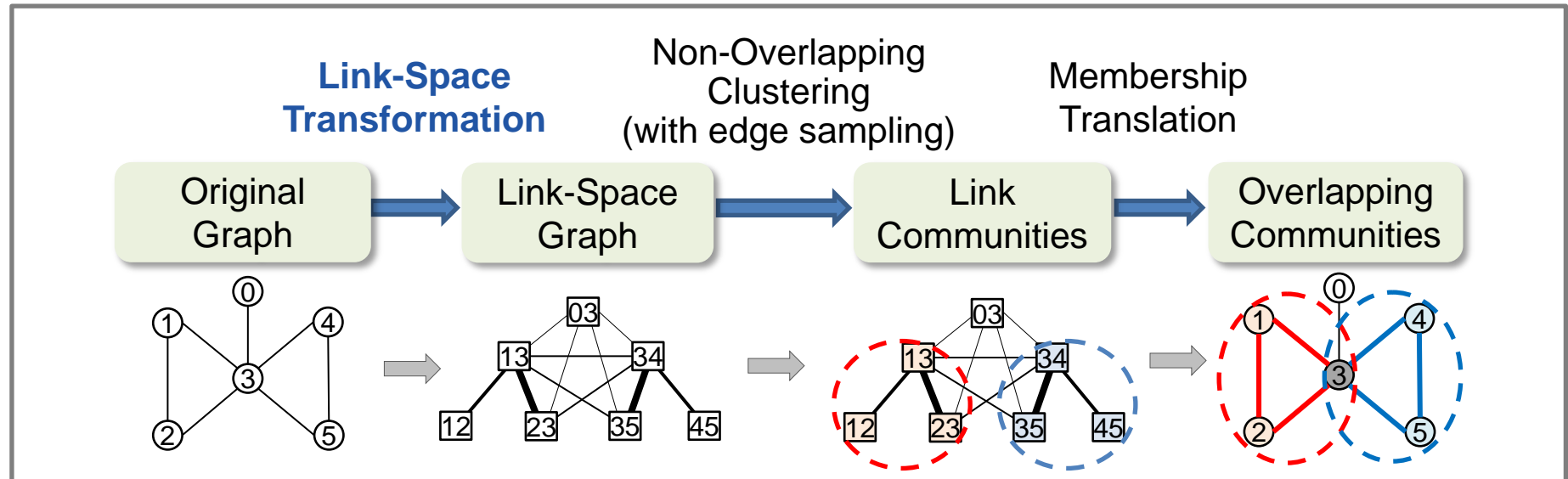
- **Topic:** Analyzing the *spread of information in complex networks*



- **Previous Work:** Limitations on graph structure (tree-like) and states (binary)
- **Contributions**
 - Proposing a *generalized mean-field approximation* that relaxes the condition on strong symmetry (arbitrary graphs and multiple adoption states)
 - Proving that the cascade sizes is *highly concentrated* around the expected value with high probability

Highlight 2: Overlapping Clustering [ICDE 14, TKDE 18+]

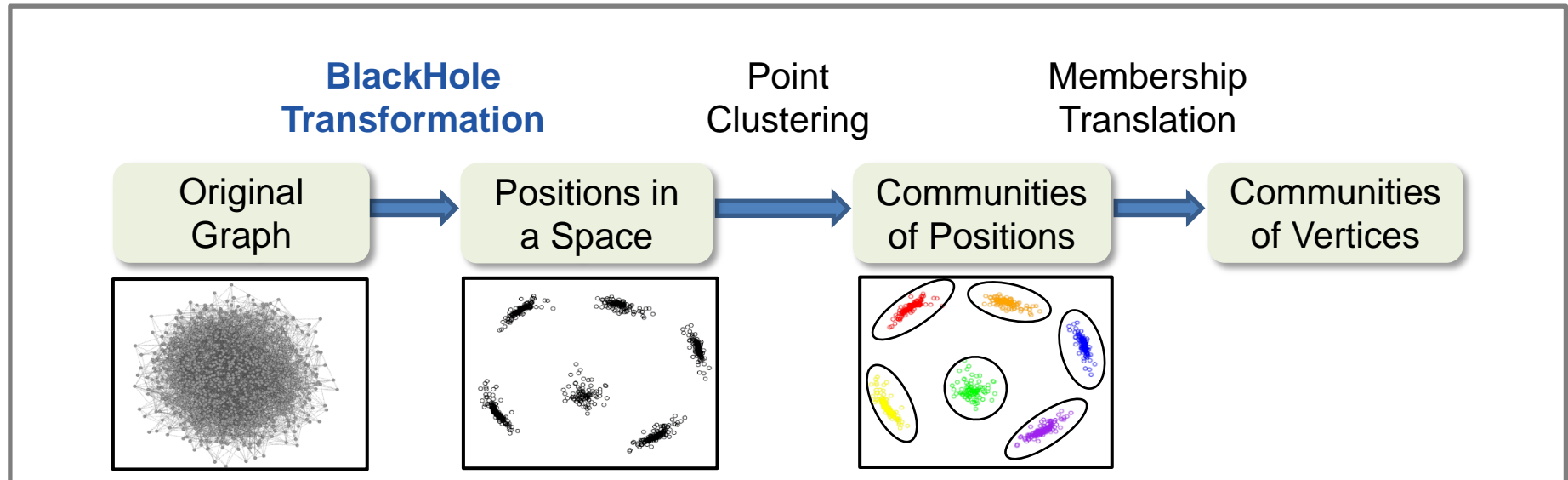
- **Topic:** Identifying *overlapping communities in social networks*



- **Previous Work:** Conventional algorithms usually find disjoint communities
- **Contributions**
 - Proposing the *link-space transformation* that transforms a given graph into the link-space graph
 - Developing an algorithm that performs a *non-overlapping clustering on the link-space graph* (easier problem), which enables us to discover overlapping clustering

Highlight 3: Graph Embedding [ICDE 16, JSTAT 16, TKDE 18+]

- **Topic:** Identifying *highly interconnected communities in social networks*



- **Previous Work:** Conventional algorithms are often not robust to high mixing
- **Contributions**
 - Proposing the *BlackHole transformation* that transforms a given graph into the points in a low-dimensional space
 - Developing an algorithm that performs clustering on the embedded space, which enables us to discover *highly mixed communities*

Research Plans

● Research Topics

- ***Understanding complex systems with big data analytics***
- Developing algorithms for solving intelligence and real-world data problems

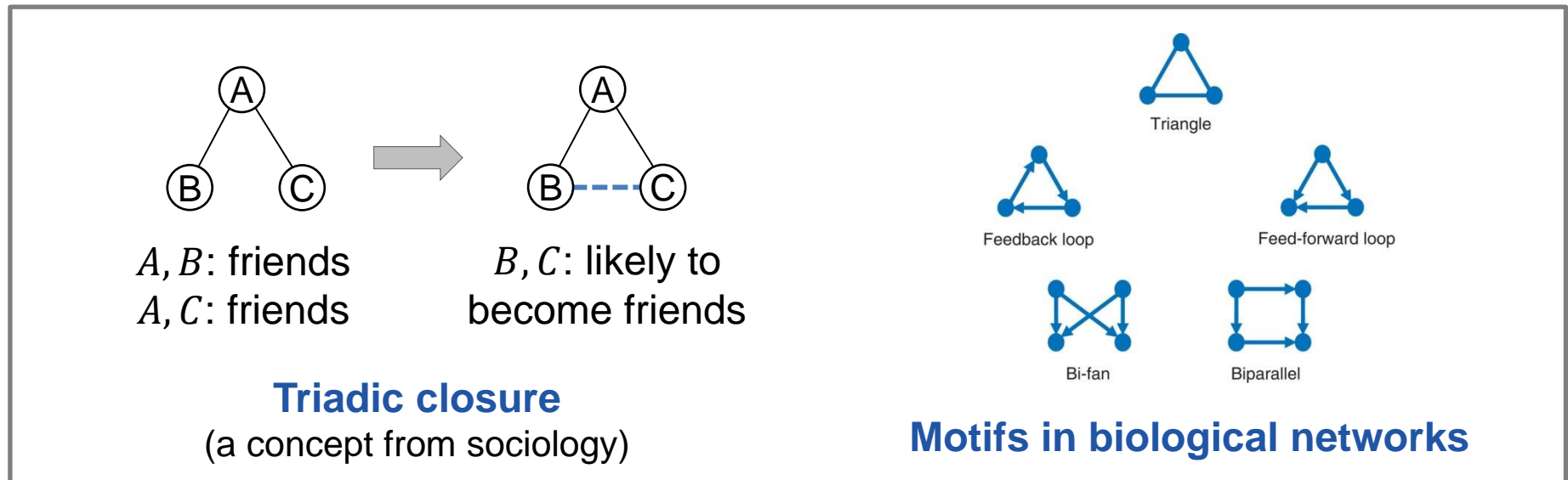
● Recent Topics

- **Big Data Analytics: Privacy-Preserving Methods**
- **Network Science: Graph Compression**
- **Artificial Intelligence: Statistical Inference**



On-Going: Higher-Order Network Analysis

- **Goal:** Developing *network analysis using higher-order relationships*

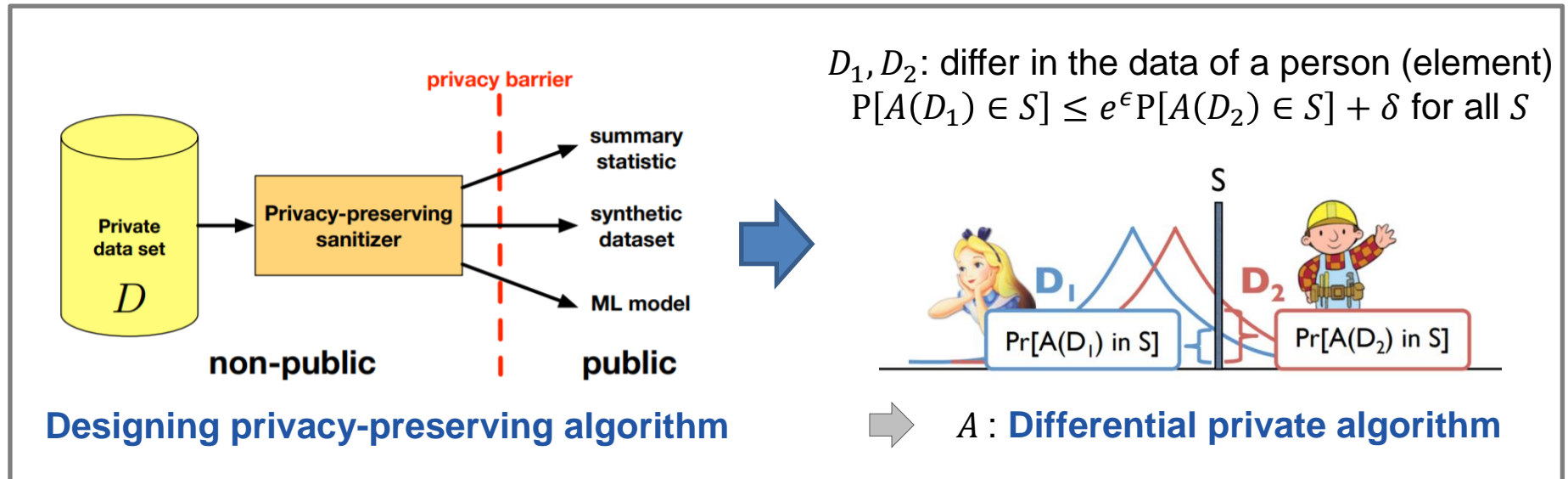


- **Methods**

- Considering higher-order graph substructures, called the network motifs or graphlets, is important to *capture the structural dependencies in networks*
- Using the motif-based weighting and graph embedding method, we are working on interesting problems for *big graph data management and analysis*

On-Going: Privacy-Preserving Network Analysis

- **Goal:** Developing *effective privacy-preserving techniques for network data*

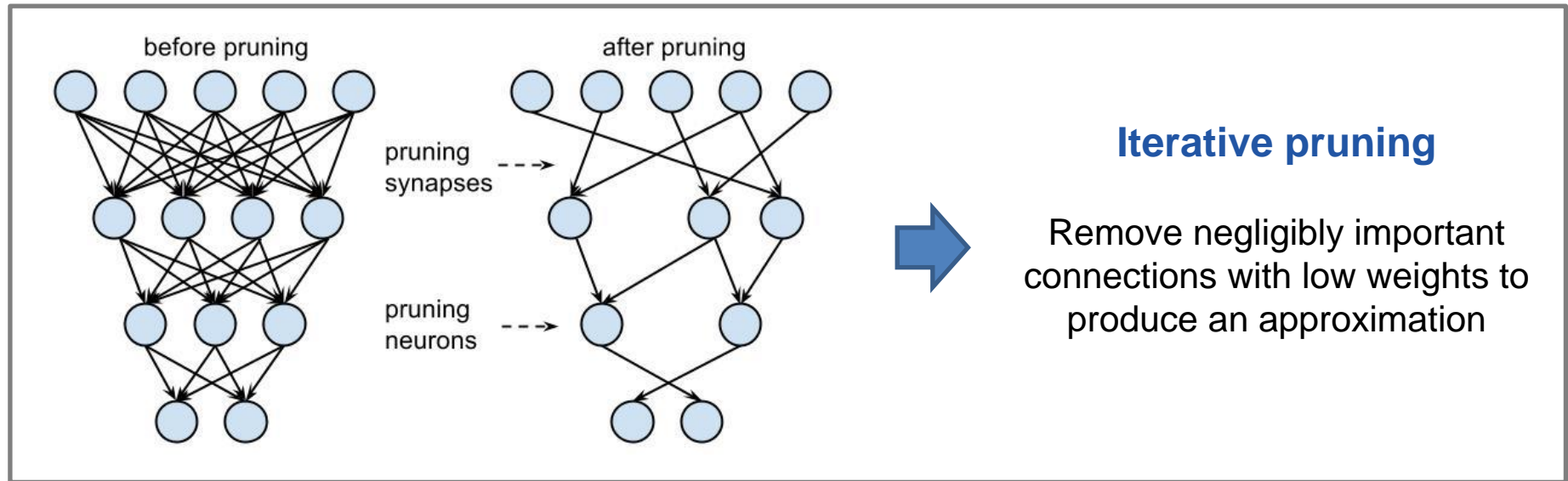


- **Methods**

- Increasing data complexity (volume, variety, velocity) due to data sources and sizes causes the *privacy concerns about big data*
- Using the differential privacy, a mathematical framework for protecting data privacy, we develop data mining models that achieve *good utility and privacy protection*

On-Going: Graph Compression

- **Goal:** Developing *efficient learning algorithms for deep neural networks*



- **Methods**

- Designing and analyzing *iterative pruning algorithm for deep neural networks* that is fast with quite good accuracy
- Using the proposed algorithm, we develop an *on-device deep learning* platform for the mobile and embedded applications

Thank You Very Much!
Any Questions?