PACE 2027

Juha Harviainen[1], André Schidler[2], Frank Sommer[3]

[1]University of Helsinki, Finland
[2]University of Freiburg, Germany
[3]University of Jena, Germany

https://pacechallenge.org/

Scientific Topic: Longest Path

Definition

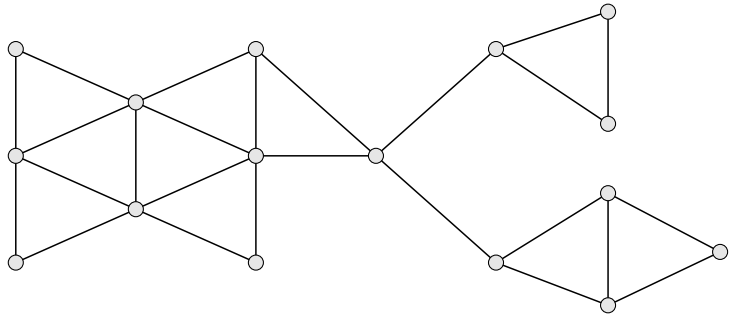
- A k-**path** is a simple path on k vertices.

Scientific Topic: Longest Path

Definition

- A k-**path** is a simple path on k vertices.
- **Longest Path**: given an undirected graph G, find the largest k such that G contains a k-path as a subgraph.

G



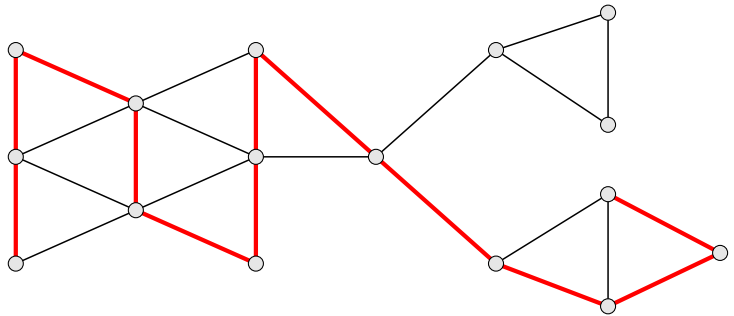
Scientific Topic: Longest Path

Definition

- A k-**path** is a simple path on k vertices.
- **Longest Path**: given an undirected graph G, find the largest k such that G contains a k-path as a subgraph.

G

$k = 13$



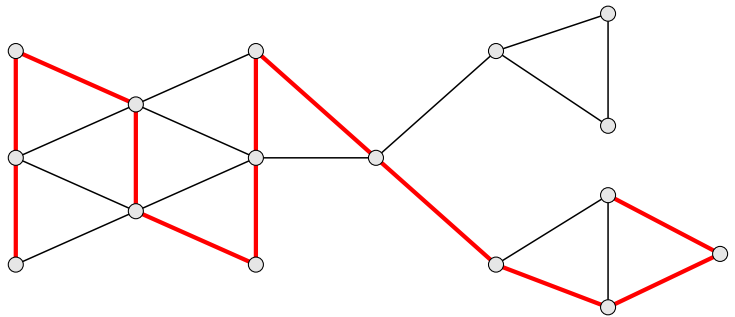
Scientific Topic: Longest Path

Definition

- A k-**path** is a simple path on k vertices.
- **Longest Path**: given an undirected graph G, find the largest k such that G contains a k-path as a subgraph.
- In the **weighted variant** the edges carry weights and, for a given k, a k-path of maximum total weight is asked for.

G

$k = 13$



Scientific Topic: Longest Path

Definition

- A **k-path** is a simple path on k vertices.
- **Longest Path**: given an undirected graph G, find the largest k such that G contains a k-path as a subgraph.
- In the **weighted variant** the edges carry weights and, for a given k, a k-path of maximum total weight is asked for.

Results for parameter k

- NP-hard — Karp '72
- randomized $O^*((2e)^k)$ — Alon, Yuster, Zwick '95
  randomized $O^*(1.66^k)$ — Björklund, Husfeldt, Kaski, Koivisto '17
- deterministic $O^*(2.554^k)$ — Tsur '19
- no polynomial kernel unless NP $\subseteq$ coNP/poly — Bodlaender, Downey, Fellows, Hermelin '09

Scientific Topic: Longest Path

Definition

- A **k-path** is a simple path on k vertices.
- **Longest Path**: given an undirected graph G, find the largest k such that G contains a k-path as a subgraph.
- In the **weighted variant** the edges carry weights and, for a given k, a k-path of maximum total weight is asked for.

Results for parameter k

- NP-hard — Karp '72
- randomized $O^*((2e)^k)$ — Alon, Yuster, Zwick '95
  randomized $O^*(1.66^k)$ — Björklund, Husfeldt, Kaski, Koivisto '17
- deterministic $O^*(2.554^k)$ — Tsur '19
- no polynomial kernel unless NP $\subseteq$ coNP/poly — Bodlaender, Downey, Fellows, Hermelin '09

Results for treewidth tw

- randomized $4^{\mathrm{tw}} n^{O(1)}$ — Cygan et al. '11
- deterministic $2^{O(\mathrm{tw})}$ — Bodlaender et al. '15
- Hamiltonicity: $(2+\sqrt{2})^{\mathrm{pw}}$ — Cygan, Kratsch, Nederlof '13

Organization and Data

Exact Unweighted Track

- **undirected, unweighted** graph G
- output: largest k such that G has a k-path

Organization and Data

Exact Unweighted Track

- **undirected, unweighted** graph G
- output: largest k such that G has a k-path

Heuristic Track

- **unweighted, undirected** graph G
- lower bounds

Organization and Data

Exact Unweighted Track

- **undirected, unweighted** graph G
- output: largest k such that G has a k-path

Heuristic Track

- **unweighted, undirected** graph G
- lower bounds

Exact Weighted Track

- **directed, weighted** G and integer k
- output: a k-path of maximum weight

Organization and Data

Exact Unweighted Track

- **undirected, unweighted** graph G
- output: largest k such that G has a k-path

Heuristic Track

- **unweighted, undirected** graph G
- lower bounds

Exact Weighted Track

- **directed, weighted** G and integer k
- output: a k-path of maximum weight

Data

real-world and generated graphs, rather **sparse**, many structural parameters are **small**

Organization and Data

Exact Unweighted Track

- **undirected, unweighted** graph G
- output: largest k such that G has a k-path

Heuristic Track

- **unweighted, undirected** graph G
- lower bounds

Exact Weighted Track

- **directed, weighted** G and integer k
- output: a k-path of maximum weight

Data

real-world and generated graphs, rather **sparse**, many structural parameters are **small**

Solver Review

- in the exact tracks, solvers with **one-sided error probability** are allowed
- pure heuristics will be disqualified
- participants may **inspect** other solvers

Timeline

mostly follows previous PACE-instances

September '26	Announcement of the challenge and tracks
October '26	Definition of the formats, tiny test set and verifier
January '27	Release of public instances and details about the benchmark
April '27	Submission via optil.io opens
early July '27	Final submission deadline
mid July '27	Solver review phase
end of July '27	Announcement of results

Timeline

mostly follows previous PACE-instances

September '26	Announcement of the challenge and tracks
October '26	Definition of the formats, tiny test set and verifier
January '27	Release of public instances and details about the benchmark
April '27	Submission via optil.io opens
early July '27	Final submission deadline
mid July '27	Solver review phase
end of July '27	Announcement of results

– good luck and an enjoyable competition –