Research Topics in Algorithm Engineering Group

**Shortest paths**, researcher Tian Lin, Masters

```
1 --2 --3 --4
20  4  6  2
9
```

$n = 4$, number of vertices
$m = 6$, number of edges

Single source best result in general $O(m + n \log n)$
size of largest sc-components $k$, $O(m + n \log k)$, Takaoka 1995
number of trigger vertices $r$, $O(m + r \log r)$, Shane 2004

All pairs, researcher Tad

```
0 2 5 14
7 0 3 12
4 6 0 9
- - - 0
```

$O(n^3 \log \log n / \log n)$, Takaoka 2005

**Combinatorial generation.** To generate combinatorial objects in $O(1)$ time per object
Example of parenthesis strings

```
((()))
(()())
()()()
()()

Topics parenthesis strings
multiset permutations
multiset combinations

D. E. Knuth Volume 4

Ivory tower research

Steve Violich: Mixed parenthesis strings
Multiset permutations
```
Maximum subarray problem,
researcher Sung Eun Bae, Ph.D candidate
Mohammad Basher, Masters
To identify consecutive array portions with maximum sum
in one-dimensional or two-dimensional arrays

One dimension: application for bio-informatics
Two dimension: promising customer range in sales database
  brightest spots in graphical images
  Mesh algorithm patented

Data structures  3-4 heap, extension of 2-3 heap
Tobias Bethlehem, Masters

Programming language and axiomatic semantics
Ryan Mallon, Masters, history variables