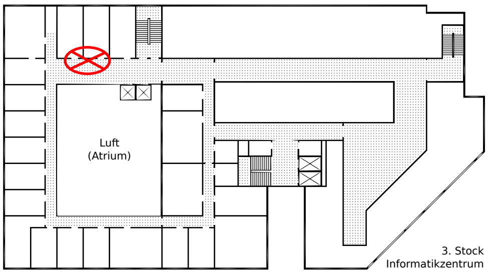
Algorithms Group **Summer '15**
Departement of Computer Science - IBR
TU Braunschweig

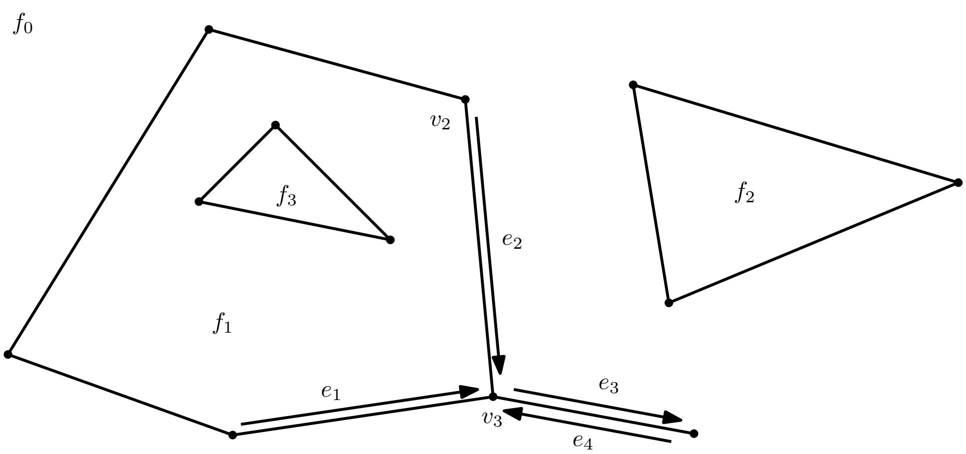
Michael Hemmer

Geometric Algorithms
Exercise 1
April 23, 2015



This sheet is comprised of several exercise. The solutions should be handed in by **Thursday April 30** until 19:00pm. This can be done by placing them in the appropriate box of the exercise locker, see floor plan on the right.
In order to achieve the *"Studienleistung"*, you must achieve 50% of the points over all exercise sheets and you must have presented at least two exercises until the end of the term. Please mark those exercises that you would like to present during the tutorial.

Exercise T1 (Doubly Connected Edge List):



a) Consider the picture above and give a call sequence to reach:
- v_3 from e_1
- e_4 from e_1
- f_1 from e_4
- f_1 from f_3
- f_0 from e_1

For instance, we can reach v_3 from e_2 by:

$$v_3 = e_2.next().source()$$

(5 P.)

b) Given the DCEL above. How could one easily identify low dimensional features, that is, e_3 and e_4?

(3 P.)

c) Give an example of a DCEL where *e.face()* == *e.twin().face()* for some edge e.

(2 P.)

Exercise T2 (DCEL):

a) Give a general function to iterate over all faces starting from the infinite face f_0.

(10 P.)

b) Give an algorithm that lists all neighbors of a given vertex v.

(5 P.)

For an advanced implementation of the interface you may want to have a look at:
http://doc.cgal.org/latest/Arrangement_on_surface_2/classCGAL_1_1Arrangement__2.html

Exercise T3 (Euler's Formula):

Let $G = (V, E)$ be a simple, connected, planar graph and let F be the set of all faces of G.

a) Prove Euler's Formula:

$$|V| - |E| + |F| = 2$$

(15 P.)

b) Prove that for $|V| \geq 3$ the following inequality holds:

$$|E| \leq 3|V| - 6$$

(10 P.)