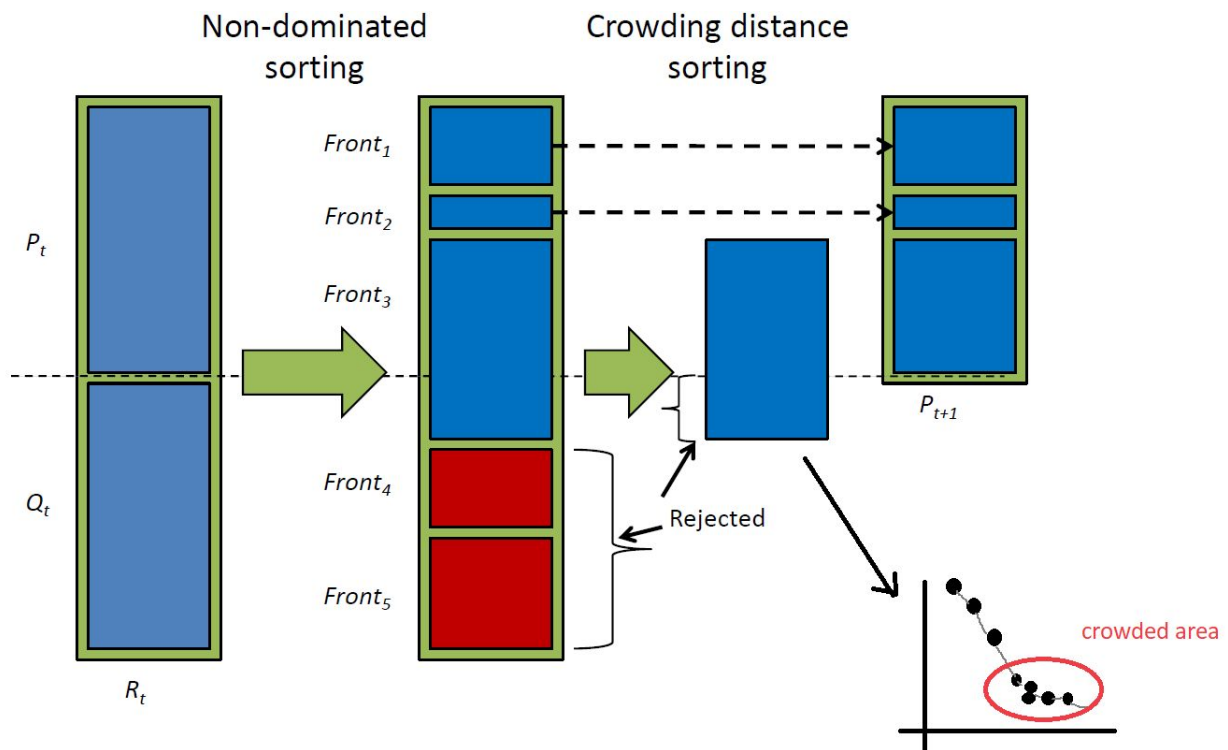## Assignment 22 (NSGA - II)

Take a look at the NSGA-II algorithm from the lecture and answer the following questions.

- Explain the basic concept of NSGA-II and how it ranks the solutions during the selection process.

- Based on non-dominated sorting.
- Divides the population into several fronts
- Select from the best fronts one after the other.



Source: Lecture Slides

## fast-non-dominated-sort$(P)$

for each $p \in P$
    $S_p = \emptyset$
    $n_p = 0$
    for each $q \in P$
        if $(p \prec q)$ then
            $S_p = S_p \cup \{q\}$
        else if $(q \prec p)$ then
            $n_p = n_p + 1$
    if $n_p = 0$ then
        $p_{\text{rank}} = 1$
        $\mathcal{F}_1 = \mathcal{F}_1 \cup \{p\}$

Source: Lecture Slides

$i = 1$
while $\mathcal{F}_i \neq \emptyset$
    $Q = \emptyset$
    for each $p \in \mathcal{F}_i$
        for each $q \in S_p$
            $n_q = n_q - 1$
            if $n_q = 0$ then
                $q_{\text{rank}} = i + 1$
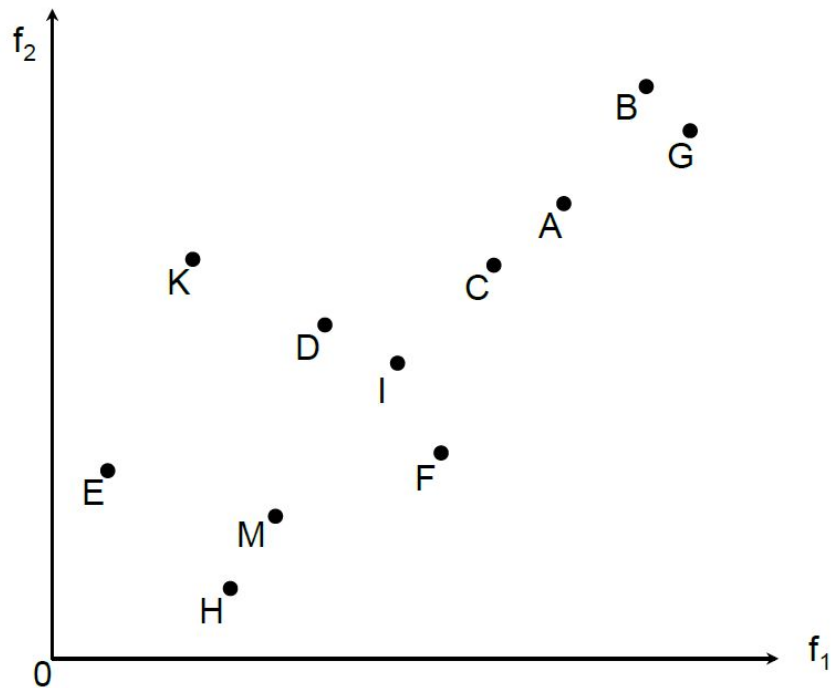                $Q = Q \cup \{q\}$
    $i = i + 1$
    $\mathcal{F}_i = Q$

Source: Lecture Slides

- Given the following set of solutions in a multi-objective optimization problem, where both objectives should **be minimized**. Identify all the non-dominated fronts by using non-dominated sorting.

$S_H = \{M, F, I, D, C, A, B, G\}$

$S_E = \{D, I, F, C, A, B, G, K\}$

$S_K = \{A, B, G\}$

$S_M = \{D, I, F, C, A, B, G\}$