

COMS21103: Data Structures and Algorithms**Stable Roommate Problem**

Irving's algorithm: References Irving, Robert W. (1985), "An efficient algorithm for the stable roommates problem", Journal of Algorithms 6 (4): 577595

Pseudocode

while *there are unmatched people* **do**

 Let i be the smallest value such that a_i is unmatched

a_i proposes to his favourite roommate a_j who has not rejected him previously

if a_j *has not received a proposal before* **then**

a_j accepts a_i

else

if a_j *prefers* a_i *over his current match* a_k **then**

a_j accepts a_i

a_k rejects a_j

else

a_j rejects a_i

end

end

end

for *all accepted proposals* (a_i, a_j) **do**

 reject all (a_j, a_k) where a_j prefers a_i over a_k

end

for *all cycles* (p_1, \dots, p_n) *and associated second preferences* (q_1, \dots, q_n) *such that:*

q_i *is the second preference of* p_i

p_{i+1} *is the last preference of* q_i

$p_n \in \{p_1, \dots, p_{n-1}\}$ **do**

for $i = 1..n - 1$ **do**

q_i rejects p_{i+1}

end

end

No stable matching exists if at any point a person is rejected by everyone else

Ex.

A	:	D	F	B	E	C
B	:	F	C	E	A	D
C	:	D	E	A	F	B
D	:	B	F	E	A	C
E	:	D	B	C	F	A
F	:	E	A	D	B	C

solution

1. Loop 1

(a) $A \rightarrow D$ (accept)

(b) $B \rightarrow F$ (accept)

(c) $C \rightarrow D$ (reject)

A	:	D	F	B	E	C
B	:	F	C	E	A	D
C	:	E	A	F	B	
D	:	B	F	E	A	
E	:	D	B	C	F	A
F	:	E	A	D	B	C

(d) $C \rightarrow E$ (accept)

(e) $D \rightarrow B$ (accept)

(f) $E \rightarrow D$ (accept) – $A \rightarrow D$ (reject)

A	:	F	B	E	C	
B	:	F	C	E	A	D
C	:	E	A	F	B	
D	:	B	F	E		
E	:	D	B	C	F	A
F	:	E	A	D	B	C

(g) $A \rightarrow F$ (accept) – $B \rightarrow F$ (reject)

A	:	F	B	E	C	
B	:	C	E	A	D	
C	:	E	A	F	B	
D	:	B	F	E		
E	:	D	B	C	F	A
F	:	E	A	D	C	

(h) $B \rightarrow C$ (accept)

(i) $F \rightarrow E$ (reject)

A	:	F	B	E	C	
B	:	C	E	A	D	
C	:	E	A	F	B	
D	:	B	F	E		
E	:	D	B	C	A	
F	:	A	D	C		

(j) $F \rightarrow A$ (accept)

2. Loop 2

(a) $C \rightarrow E$ – $E \rightarrow A$ (reject)

A	:	F	B	C		
B	:	C	E	A	D	
C	:	E	A	F	B	
D	:	B	F	E		
E	:	D	B	C		
F	:	A	D	C		

(b) $D \rightarrow B$ – nothing

(c) $E \rightarrow D$ – nothing

(d) $A \rightarrow F - F \rightarrow D$ (reject) and $F \rightarrow C$ (reject)

A : F B C
 B : C E A D
 C : E A B
 D : B E
 E : D B C
 F : A

(e) $B \rightarrow C$ – nothing

(f) $F \rightarrow A - A \rightarrow B$ (reject) and $A \rightarrow C$ (reject)

A : F
 B : C E D
 C : E B
 D : B E
 E : D B C
 F : A

3. Loop 3

(a) First circular

p_i : B C D C
 q_i : E B E

i. $E \rightarrow C$ (reject)

A : F
 B : C E D
 C : B
 D : B E
 E : D B
 F : A

ii. $B \rightarrow D$ (reject)

A : F
 B : C E
 C : B
 D : E
 E : D B
 F : A

(b) Second circular

p_i : B B
 q_i : E

$E \rightarrow B$ (reject)

A : F
 B : C
 C : B
 D : E
 E : D
 F : A

(c) No more circulars

4. Final stable pairs: $\{(A,F), (B,C), (D,E)\}$