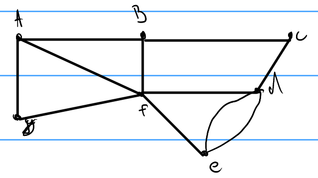
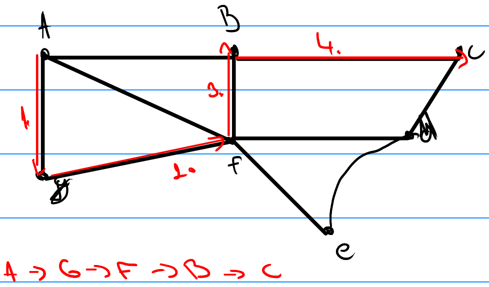
ADM Zápočet 2.

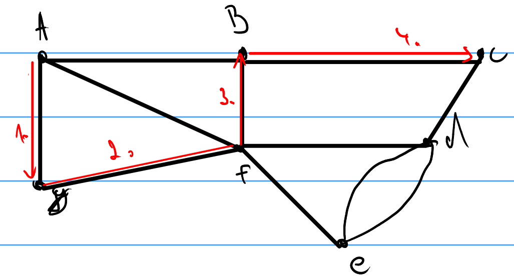


Trail z $A \to C$



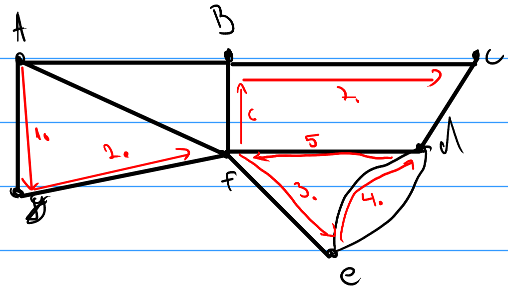
$A \to G \to F \to B \to C$

PATH z $A \to C$



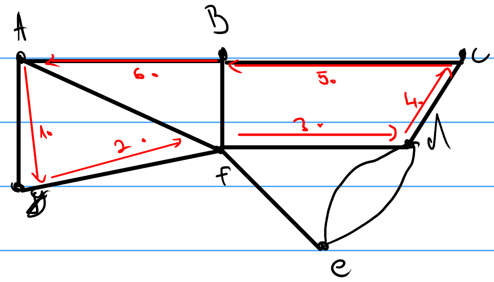
$A \to G \to F \to B \to C$

Walk z $A \to c$



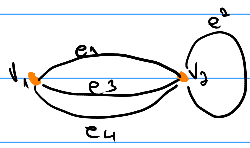
$A \to G \to F \to E \to D \to F \to B \to C$

Cycle z $A \to C$

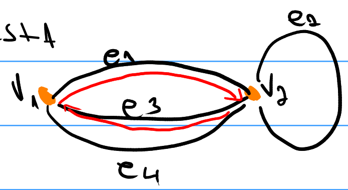


$A \to G \to F \to D \to C \to B \to A$

G

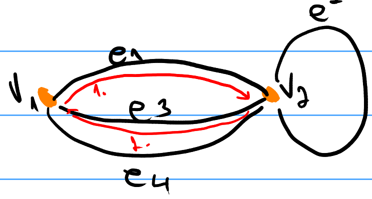


cesta



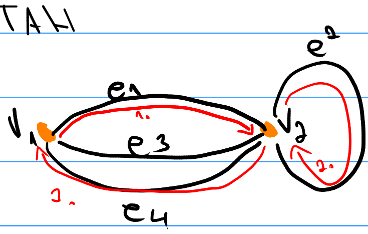
$V_1 \to e_1 \to V_2 \to e_3$

cyklus ⇒ (uzavretá PAth)



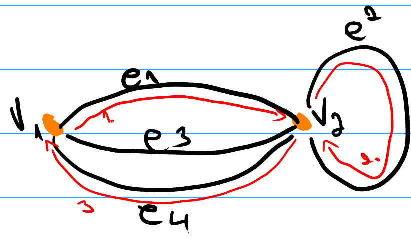
$V_1 C_1 \to V_2 e_3 \to V_1$

TAH



$V_1 e_1\ V_2 e_2\ e_4$

circut - uzavretá tah okruh



$V_1 e_1 V_2 e_2\ V_2 e_4 V_1$

WALK (opakuje sa všetko)

TRAIL	PATH
opak. vrcholy	neopakujú vrcholy
neopak. hrany	opak. hrany
↓	↓
CIRCUIT	CYCLE
(UZAVRETÝ TRAIL)	(UZAVRETÁ CESTA)

2, Spojený ? (connected) NIE

Graf je spojený ak v ňom nemáme izolované vrcholy

3, Jednoduchý ? (simple) NIE

Graf je jednoduchý ak neobsahuje násobné hrany alebo slučky

11, Eulerovský ? Semi - eulerovský ?

1, G je spojitý ÁNO — NIE JE Eulerovský

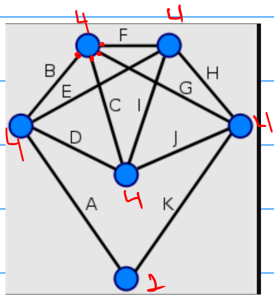
2, Všetky vrcholy majú párny stupeň NIE, lebo deg(e) = 5

1, G je spojitý ÁNO — JE Semi - Eulerovský

2, Práve 2 vrcholy sú nepárne ÁNO, lebo deg(b) = 3 a deg(e) = 5

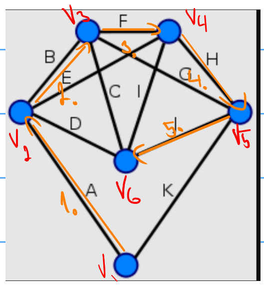
! !

Eulerovské grafa



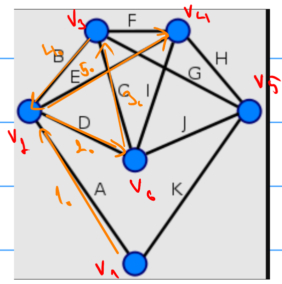
→ graf je spojitý
→ všetka vrcholy majú párny stupeň
} eulerovský graf

Path (cesta) dĺžka 5



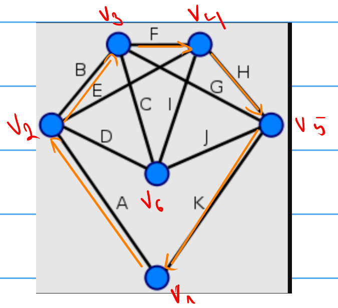
$V_1 \Rightarrow V_2 \Rightarrow V_3 \Rightarrow V_4 \Rightarrow V_5 \Rightarrow V_6$

Trail (ťah) dĺžka 5



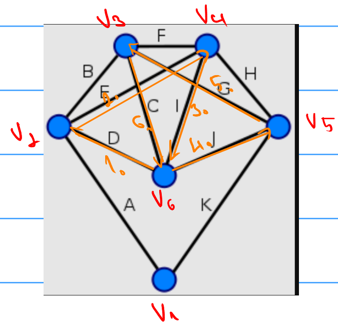
$V_1 \Rightarrow V_2 \Rightarrow V_6 \Rightarrow V_3 \Rightarrow V_2 \Rightarrow V_4$

cycle - dĺžka 5



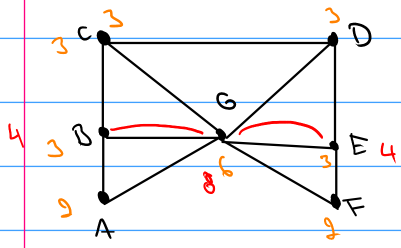
$V_1 \Rightarrow V_2 \Rightarrow V_3 \Rightarrow V_4 \Rightarrow V_5 \Rightarrow V_1$

circuit dĺžka 6



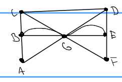
$V_6 \Rightarrow V_2 \Rightarrow V_4 \Rightarrow V_6 \Rightarrow V_5 \Rightarrow V_3 \Rightarrow V_6$

Semi eulerovský graf

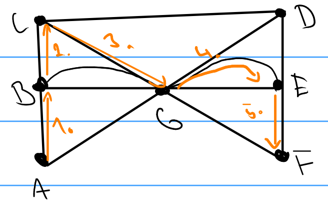


⇒ Po zmene práve 2 vrcholy majú nepárny stupeň

→ Graf je spojitý

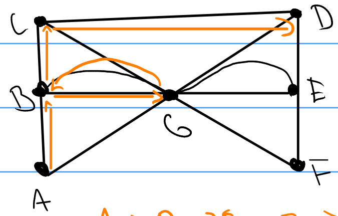


Path (cesta) - 5



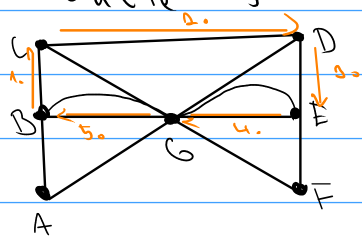
A → B → C → G → E → F

Trail (ťah) - 5



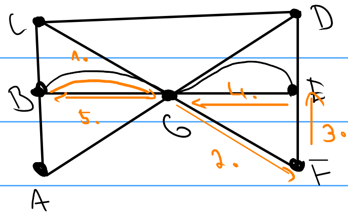
A → B → G → B → C → D

Cycle - 5



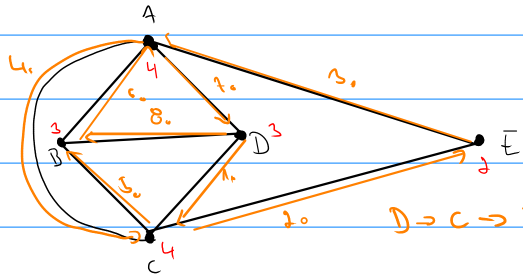
B → C → D → E → G → B

Circuit - 5



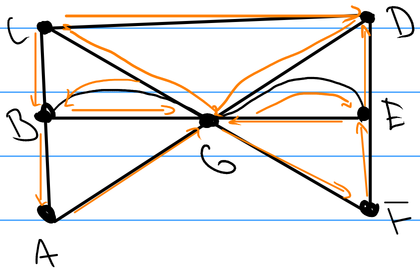
B → G → F → E → G → B

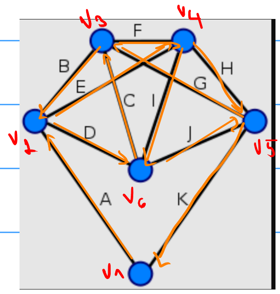
Fleury's algoritmus ⇒ (circuit so všetkými bodmi)



D → C → E → A → C → B → A → D → B

C → B → G → B → A → G → F → E → G → E → D → G → C → D



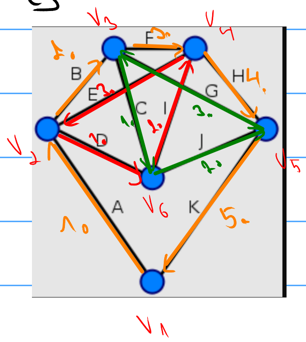


$V_1 \to V_2 \to V_6 \to V_3 \to V_2 \to V_4 \to V_6 \to V_5 \to V_3 \to V_4 \to V_5 \to V_1$

Hierholzerov algoritmus

graf je eulerovský takže to bude fungovať

G



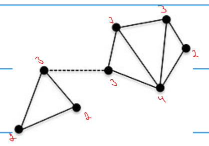
$V_1 \to V_2 \to V_3 \to V_4 \to V_5 \to V_1$

$(V_2 \to V_6 \to V_4 \to V_2)$

$(V_3 \to V_6 \to V_5 \to V_3)$

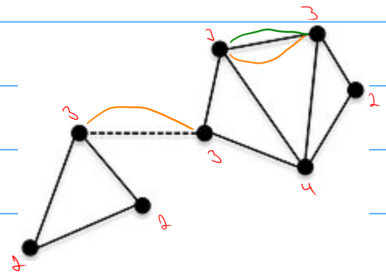
$V_1 \to V_2 \to V_6 \to V_4 \to V_2 \to V_3 \to V_6 \to V_5 \to V_3 \to V_4 \to V_5 \to V_1$

Eulerizácia, semieulerizácia



Eulerizácia ⇒

Semieulerizácia



Hamiltonovský cyklus

Platí: Ak graf má Hamilton cyklus (CYCLE) tak má aj Hamilton path (cestu)

cyklus ⇒ cesta

! Naopak to neplatí

cesta ⇏ cyklus

POSTAČUJÚCA PODMIENKA – DIRAC'S THEOREM (DIRACOVA VETA)

Veta: nech graf G má viac ako 3 vrcholy ($n \geq 3$. $|V(G)| = n$)

Ak každý vrchol grafu spĺňa podmienku $deg(v) \geq \frac{n}{2}$

potom G má Hamiltonovský cycle.

n – počet vrcholov grafu

deg(u) – stupeň vrchola

Hamilton is possible

NUTNÁ PODMIENKA (NECESSARY CONDITION)

1. G je súvislý (connected)
2. žiaden z vrcholov nemá stupeň menší ako 2
3. G neobsahuje CUT-VERTEX (ODSTRÁNITEĽNÉ VRCHOLY)
   - to sú také, ktoré keď odstránime naruší sa súvislosť grafu.

Ak všetky 3 body (1-3) sú splnené tak Hamilton PATH/CYCLE MÔŽE (ALE NEMUSÍ) EXISTOVAŤ.

Ak ktorákoľvek z týchto podmienok nie je splnená tak Hamilton PATH/CYCLE URČITE NEBUDE EXISTOVAŤ

Kompletný graf ⇒ každý vrchol je spojený s každým vrcholom

Vlastnosti kompletného grafu

1. každý vrchol v grafe K_n má stupeň $\boxed{n-1}$
2. K_n má $\frac{n \cdot (n-1)}{2}$ hrán

$C(n,2) = \frac{n \cdot (n-1)}{2}$

$\binom{n}{2}$

Travelling salesmen Problem

↳ Brute Force

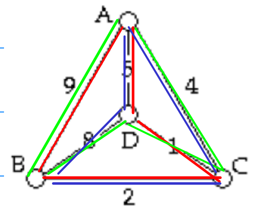
↳ Nearest Neighbour (Najbliži sused)

↳ Repetetive Nearest Neighbour (Repetetivni najbliži sused)

↳ cheapest Link Algorithm (Najlacnejšie spojenie)

↳ Nearest Insertion (

BRute force :



A→B→C→D→A

9+2+1+5 = 17

A→D→B→C→A

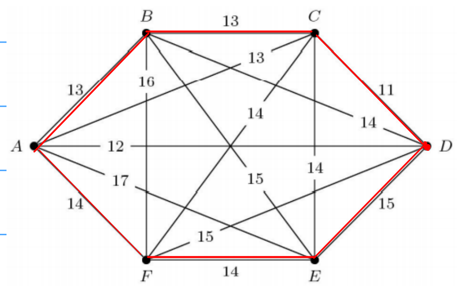
5+8+2+4 = 19

A→B→D→C→A

9+8+1+4 = 22

Pomocou BruteForce je prvý cyklus najlepší

Nearest Neighbour ⇒

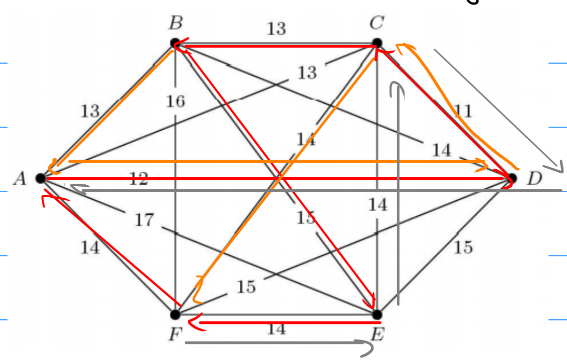


D→C→B→A→F→E

11+13+13+14+14+15 = 26+28+26 =

52+28 = 80

Repetetive Nearest Neighbour



• A→D→C→B→E→F→A

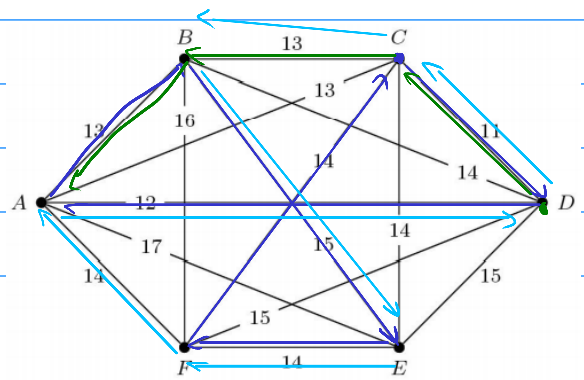
12+11+13+15+14+14 = 79

• B→A→D→C→F→E→B

13+12+11+14+14+15 = 79

F→E→C→D→A→B→F

14+14+11+12+13+16 = 80



• C→D→A→B→E→F→C

11+12+13+15+14+14 = 79

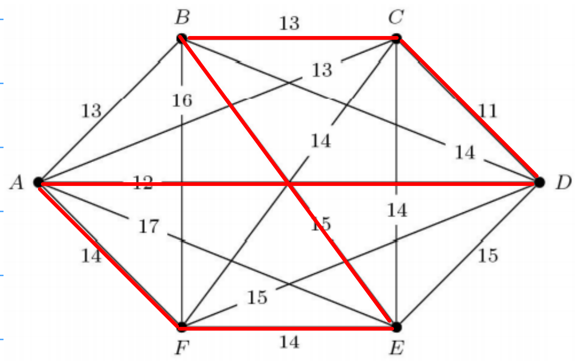
D→C→B→A→F→E→D

11+13+13+14+14+15 = 80

• E→F→A→D→C→B→E

14+14+12+11+13+15 = 79

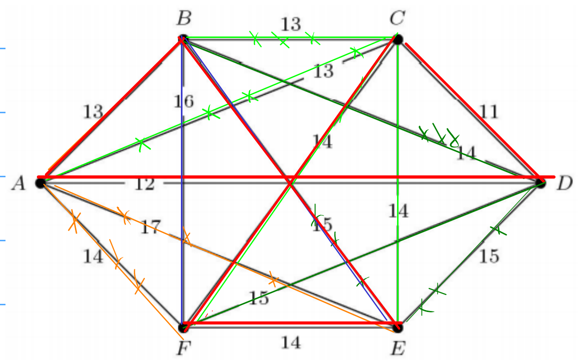
Cheapest Link algoritmus



$D \to C \to B \to E \to F \to A \to D$

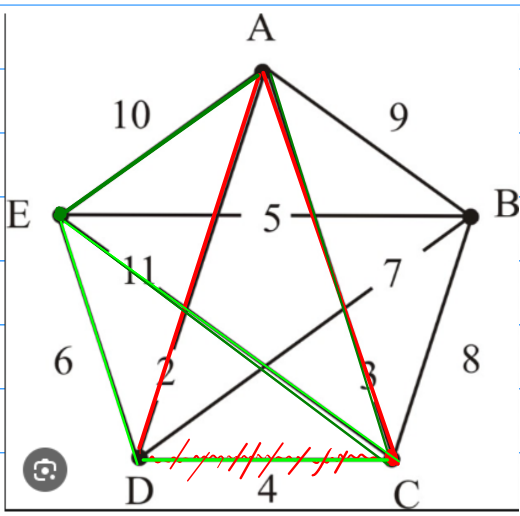
$11+13+15+14+14+12 = 79$

Nearest Insertion



$C \to D \to A \to B \to E \to F \to C$

$11+12+13+15+14+14 = 79$



E $\Delta E\,AD = 10 + 6 + 2 = 18$

B $\Delta B\,AD = 9 + 7 + 2 = 18$

C $\Delta\, CAD = 3 + 4 + 2 = 9$

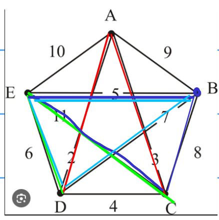
$EA = 10$ $\quad BA = 9$

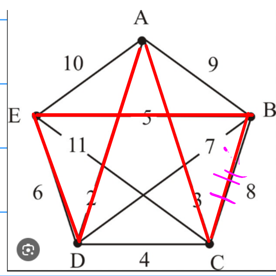
$EC = 11$ $\quad BC = 8$

$ED = 6$ $\quad BD = 7$

$ED + EC - DC = 6 + 11 - 4 = \boxed{13}$

$EA + EC - AC = 10 + 11 - 3 = 18$





← Najlepší hamiltonovská cyklu

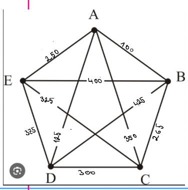
$2+6+5+8+3 = 24$

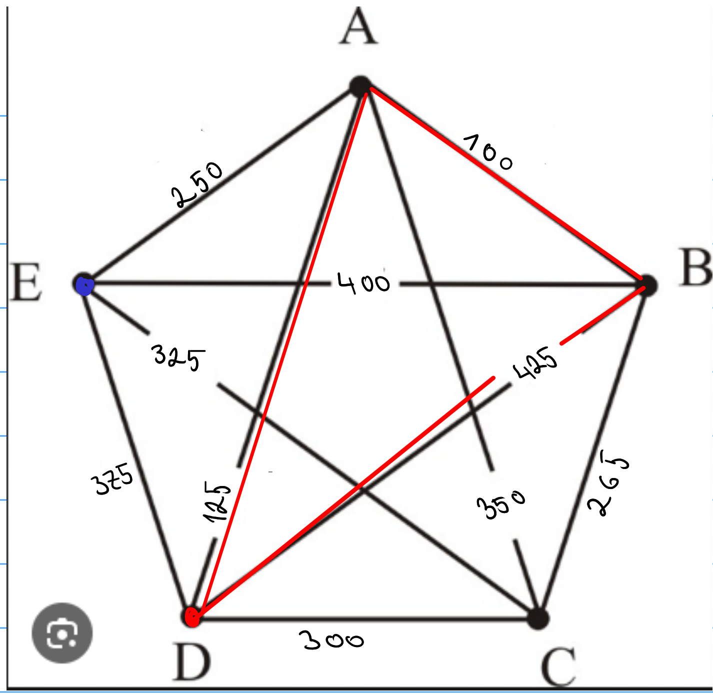
← Najlepšia hamiltonovská cesta

$2+6+5+3 = 16$

$BE + BC - EC = 5+8-11 = \boxed{2}$

$BE + BD - DE = 5+7-6 = 6$





$\triangle EAB = 250 + 100 + 400 = 750$

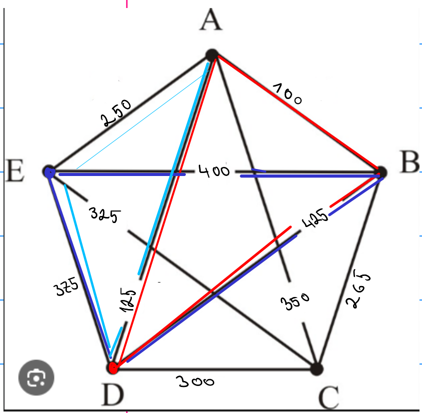
$\triangle DAB = 125 + 100 + 425 = 650$

$\triangle CAD = 350 + 100 + 265 = 725$

$EA = 250$ $\quad$ $CA = 350$

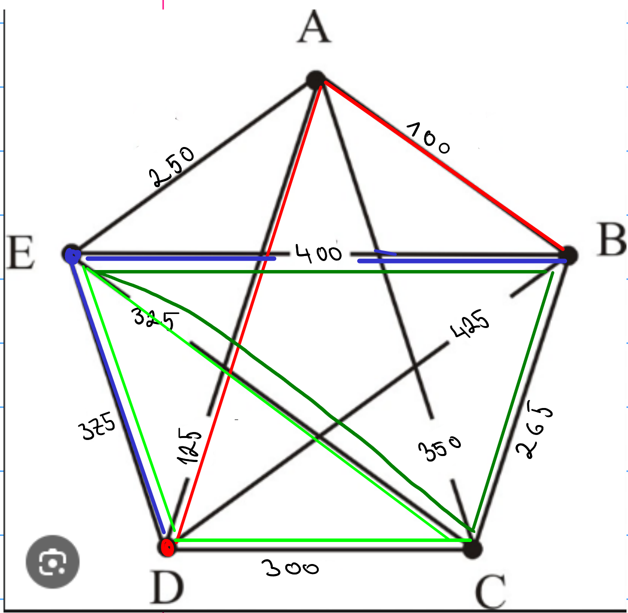
$EB = 400$ $\quad$ $CB = 265$

$ED = 375$ $\quad$ $CD = 30$



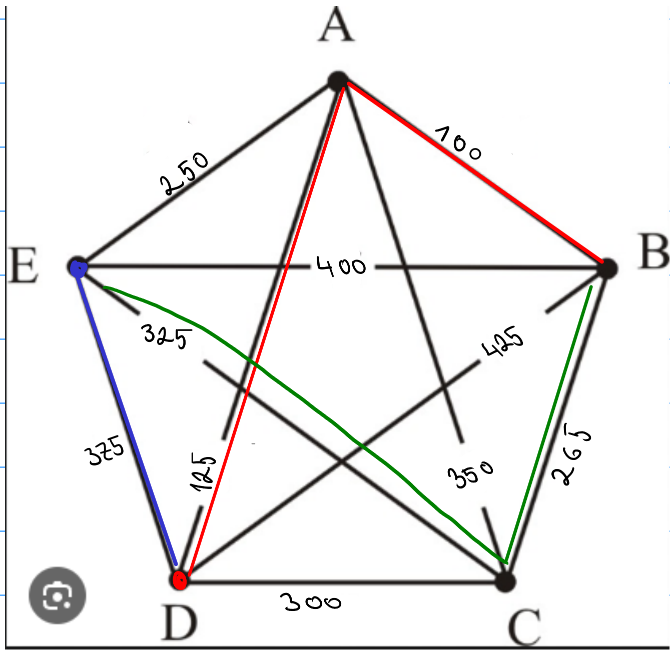
$\triangle EBD = EB + ED - BD = 400 + 375 - 425 = \boxed{350}$

$\triangle EAD = EA + ED - AD = 250 + 375 - 125 = 500$



$\triangle BCE = CB + CE - EB = 265 + 325 - 400 = 190$

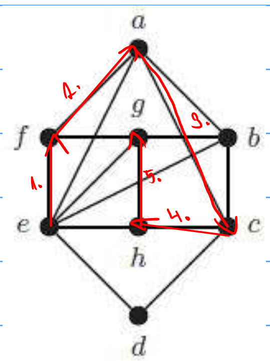
$\triangle CDE = CD + CE - DE = 300 + 325 - 375 = 250$



opakovanie:

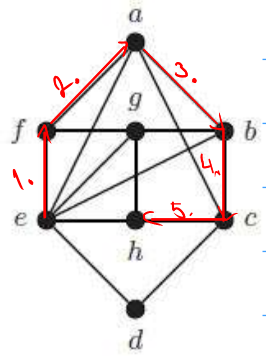
Dĺžka - 5

Walk



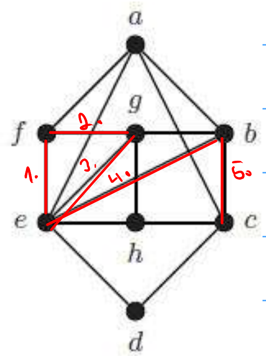
e → f → a → c → h → g

Path



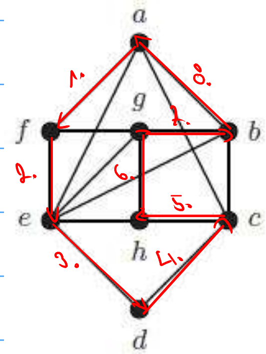
e → f → a → b → c → h

Trail



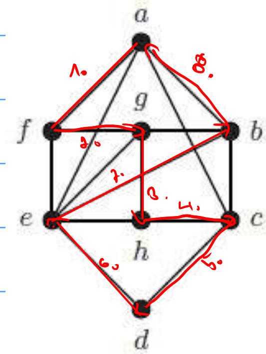
e → f → g → e → b → c

Cycle (Path)



a → f → e → d → c → h → g → b → a

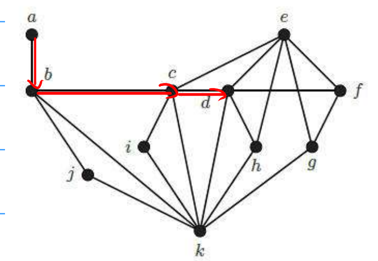
Circuit (trail)



a → f → g → h → c → d → e → b → a

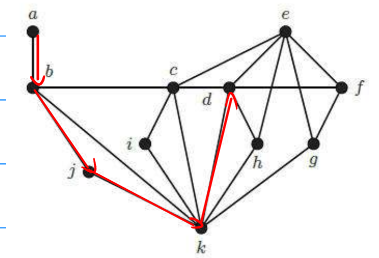
Trail/Path z A do G

Trail



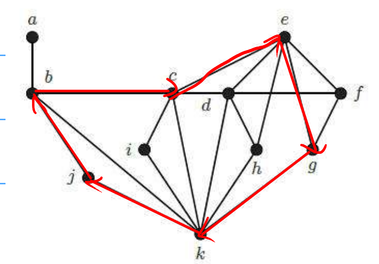
a → b → c → d

Path



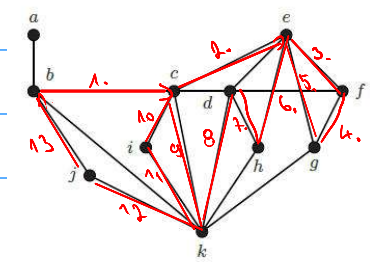
a → b → j → k → d

Cycle (Path)



b → c → e → g → k → j → b

Circuit (Trail)



b → c → e → f → g → e → h → d → k → c → i → k → j → b

Flueury's algorythm :

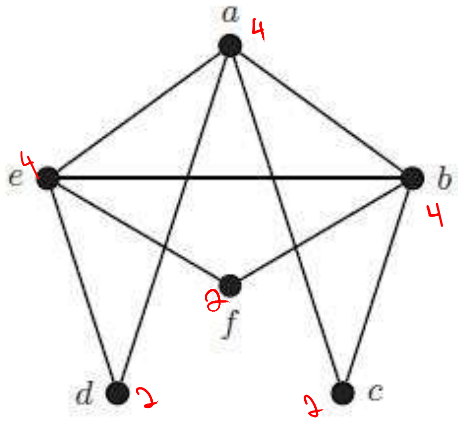
Podmienka :

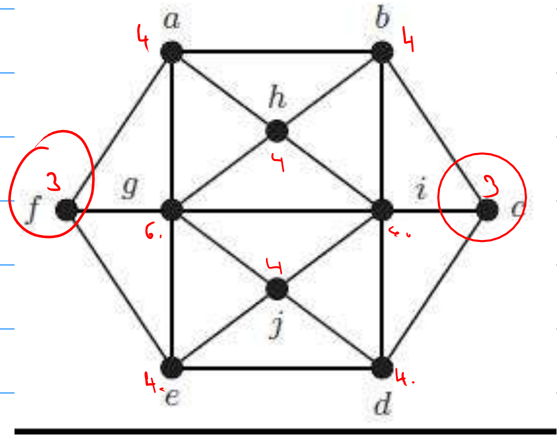
• eulerovský / semi-eulerovský ✓

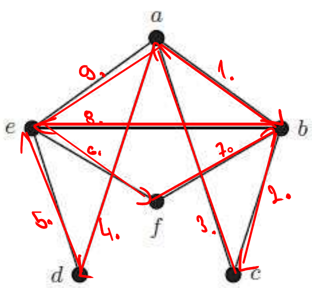
• Súvislý graf ✓ nemá Iz. bod

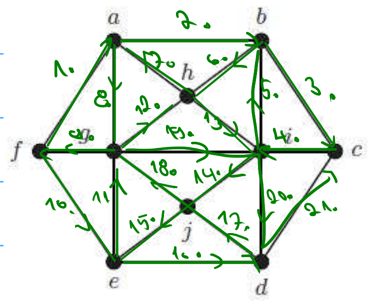
• Semi-eulerovský graf ✓

• Súvislý graf ✓









a → b → c → a → d → e → f → b → e → a

f → a → b → c → i → b → h → a → g → f → e → g → h → i → j → e → d → j → g → i → d → c

Hierholzerov algorythm

Podmienka :

musí byť eulerovský graf X

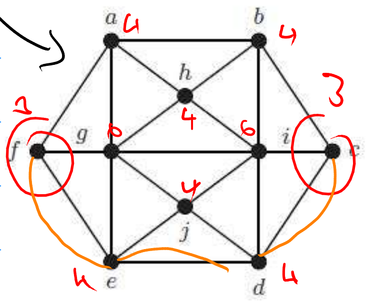
connected → ✓

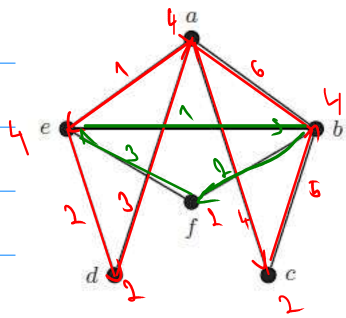
Podmienka :

musí byť eulerovský

connected

eulerizácia



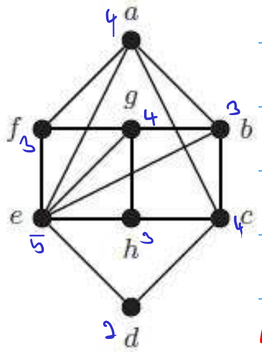


a → e → d → a → c → b → a

e → b → f → e

a → e → b → f → e → d → a → c → b → a

Podmienky:
eulerovská ✗
connected ✓



Podmienka:
eulerovská ✓
connected ✓

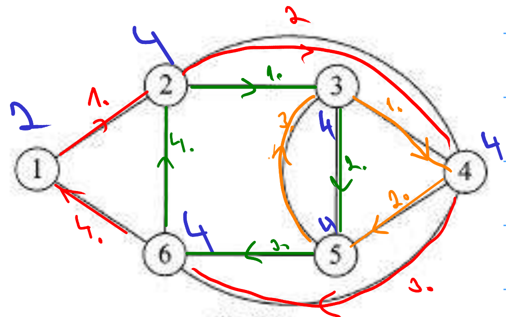


Fig. 3-2

1 → 2 → 4 → 6 → 1

2 → 3 → 5 → 6 → 2

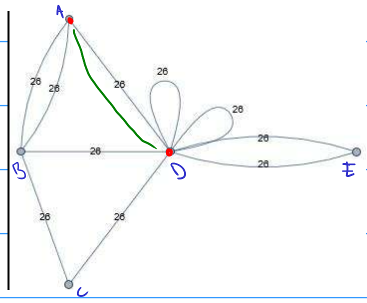
3 → 4 → 5 → 3

1 → 2 → 3 → 4 → 5 → 3 → 5 → 6 → 2 → 4 → 6 → 1

Eulerizácia → chinese Postman Problem

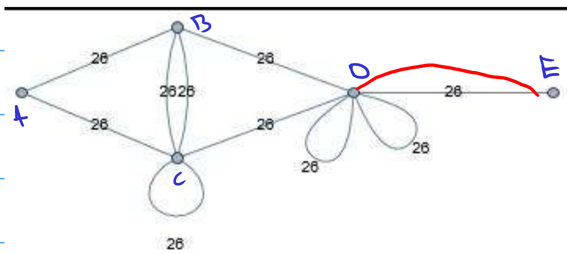
Podmienka:
spojený ✓
Musí mať nepárne vrcholy ✓

deg(A) = 3 deg(C) = 2 deg(E) = 2
deg(B) = 4 deg(D) = 3



eulerizácia ⇒ najlacnejšie je duplikácia hrany AD lebo je to priame spojenie a všetky hrany majú hodnotu 26
celková cena cesty: 26 AD

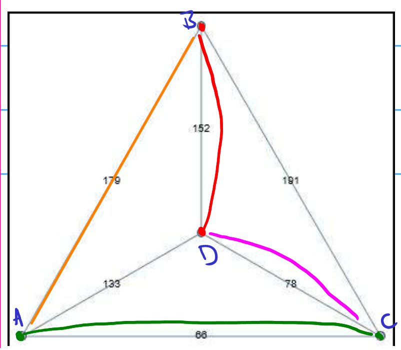
Podmienka
Nepárna hrana ✓
connected ✓



deg(A) = 2 deg(D) = 7
deg(B) = 4 deg(E) = 1
deg(C) = 6

eulerizácia DE
celková cena cesty: 26

Podmienka:
connected
Nepárne vrcholy?



deg(A) = 3
deg(B) = 3
deg(C) = 3
deg(D) = 3

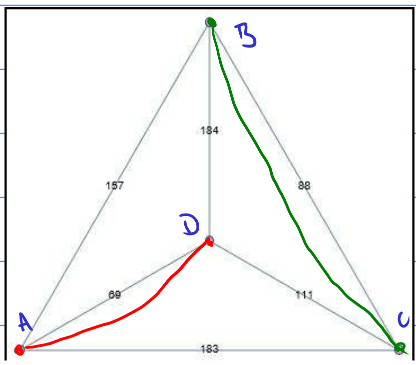
AC + DB = 66 + 152 = 218
DC + AB = 78 + 179 = 257

Po spojení 2 najkratších hrán som došiel k záveru že najlacnejšia euler. je s hranami: AC, DB
celková cena cesty: 218

Podmienky:

connected

Nepárny vrchol



deg(A,B,C,D) = (3,3,3,3)

AD + BC = 69 + 88 = 157

eulerizáciu som vykonal pomocou 2 najkratších hrán v grafe, čiže je to najefektívnejší spôsob.

eulerizácia: AD, BC

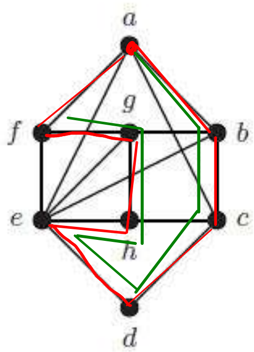
celková cena cesty: 157

Hamiltonovský cyklus a path

Podmienka

I. Nutná podmienka ✓

II. Postačujúca podmienka



I. • connected ✓

• neobsahuje cut vertex ✓

• $\forall V'(G) \geq deg(2)$ ✓

II. Dirac's theorem

$V'(G) = n \land n \geq 3 \land deg(v) \geq \frac{n}{2}$

$8 \geq 3$

hamilton cycle ⇒ a→b→c→d→e→h→g→f→A

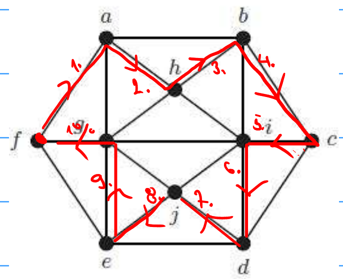
hamilton path ⇒ a→b→c→d→e→h→g→f

Najmenší deg(d) = 2

$2 < \frac{8}{2}$

Dirac theorem nesplňuje, ale neznamená to že hamil-c,p neexistuje

2) Podmienky:



I. Nutná podmienka ✓

II. Postačujúca podmienka ✗ ⇒ hamilton cyc,path môže ale nemusí ∃

I. ⇒ • connected ✓

• neobsahuje cut-vertex ✓

• $\forall V(G) \geq 2$ ✓

cycle ⇒ f→a→h→b→c→i→d→j→e→g→f

Path ⇒ f→a→h→b→c→i→d→j→e→g

II. ⇒ $V(G) = n \land n \geq 3 \land deg(V(G)) \geq \frac{n}{2}$

n = 10

najmenší stupeň = 3 $3 < 5$

3) Podmienky:

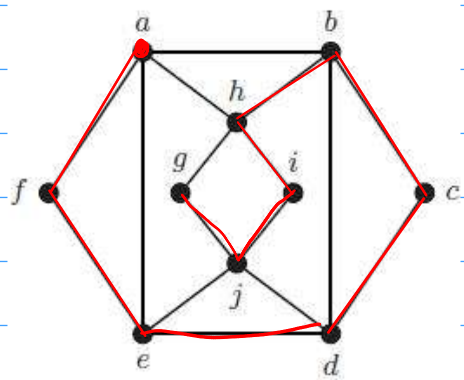
I. Nutná podmienka √

II. Postačujúca podmienka × ⇒ hamilton môže/nemusí ∃

I. ⇒ connected √

neobsahuje cut-vertex √

$\forall \deg(V(G)) \geq 2$ √



II. ⇒ Dirac's theorem

$V(G) = n \wedge n \geq 3 \wedge \deg(V(G)) \geq \frac{n}{2}$

$n = 10$, najmenší stupeň ⇒ 2

$2 < \frac{10}{2}$

hamil. Path: a → f → e → d → c → b → h → i → j → g

hamil. cycle ∄

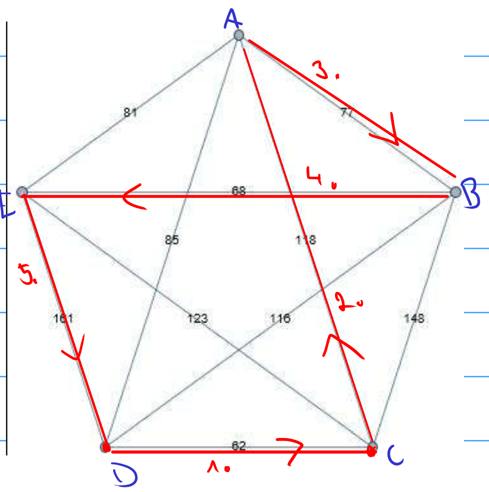
Kompletný graf (K_n) - Travelling Salesman Prob.

Vlastnosti: 1.) každý vrchol v grafe má stupeň $n-1$

2.) K_n má $\frac{n(n-1)}{2}$ hrán

Algo Brute force...

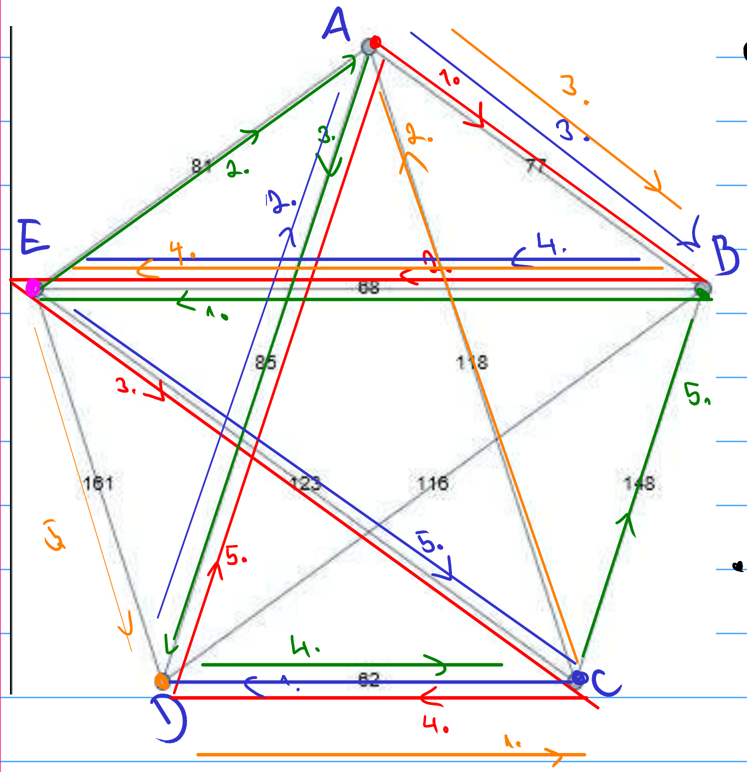
Nearest Neighbour



D → C → A → B → E → D

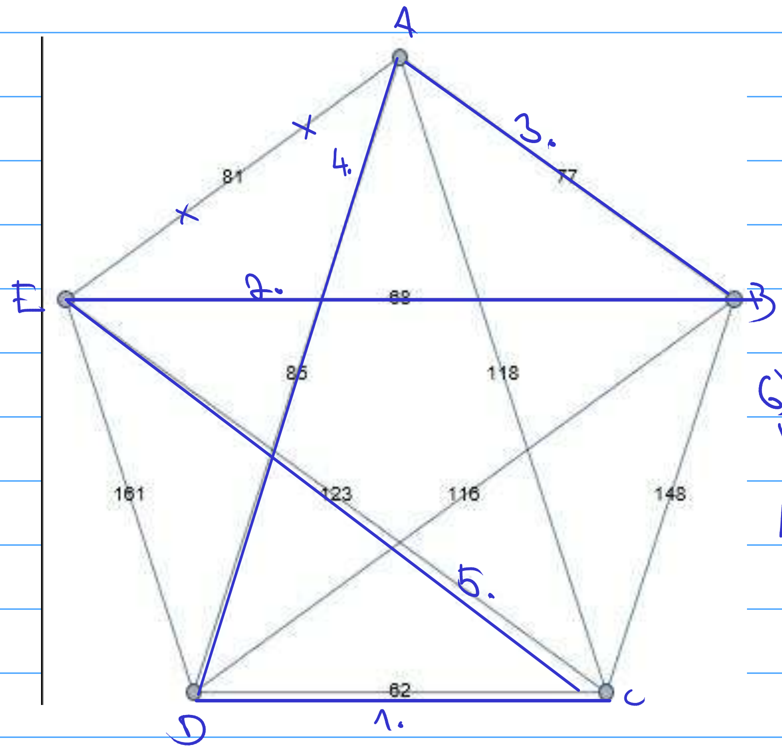
62 + 118 + 77 + 68 + 181 = 506

Repetetive NN



- $A \to B \to E \to C \to D \to A$
  $77 + 68 + 123 + 62 + 85 = 415$
- $B \to E \to A \to D \to C \to B$
  $68 + 81 + 85 + 62 + 148 = 444$
- $C \to D \to A \to B \to E \to C$
  $62 + 85 + 77 + 68 + 123 = 415$
- $D \to C \to A \to B \to E \to D$
  $62 + 118 + 77 + 68 + 161 = 486$
- $E \to B \to A \to D \to C \to E$
  $68 + 77 + 85 + 62 + 123 = 415$

Chepest link algorithm



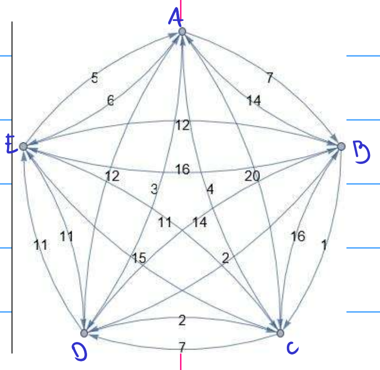
1.) DC
2.) EB
3.) BA
4.) ~~EA~~
5.) AD
6.) Dokončenie ⇒ 1 možnosť
↳ EC

$A \to B \to E \to C \to D \to A$

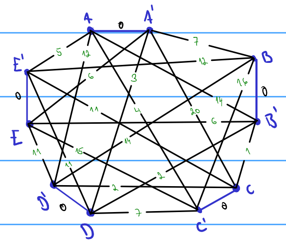
$77 + 68 + 123 + 62 + 85 = 415$

Cena Algoritmu ⇒ 415

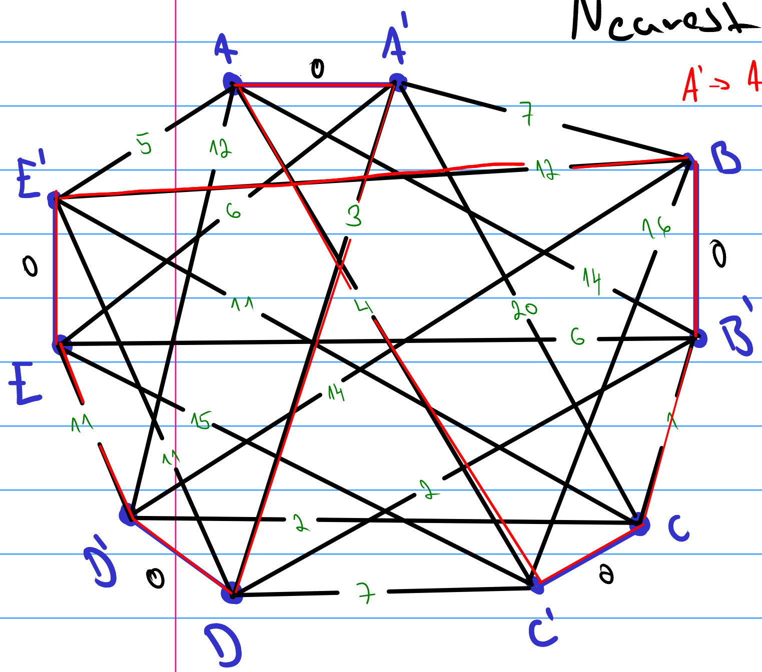
Asymmetric travelling Salesman Problem



Undirected graph

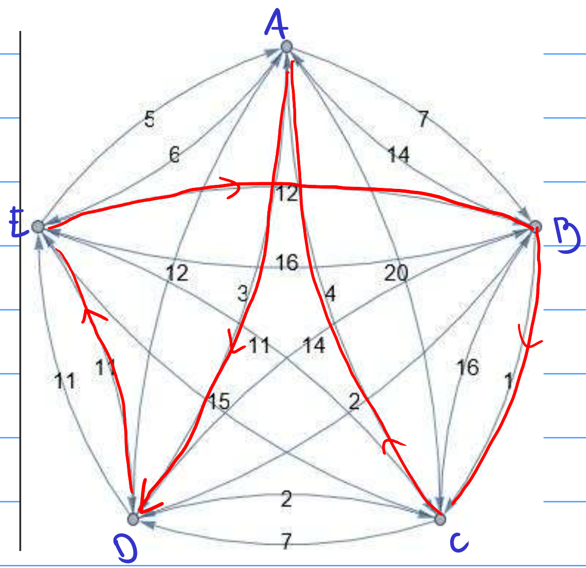


Nearest Neighbour algorithm

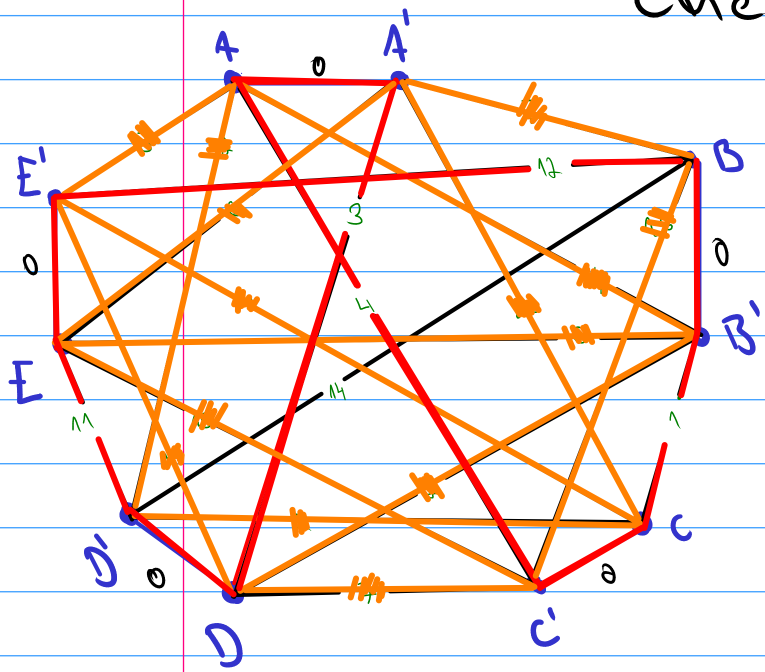


A' → A → C' → C → B' → B → E' → E → D' → D → A'

Path cost: 4 + 1 + 12 + 11 + 3 = 31



Chepest Link algorithm



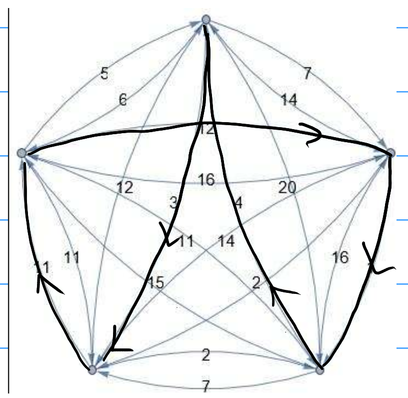
1.) A → A'   C → C'   E → E'
B → B'   D → D'

2.) CB'

3.) A'D

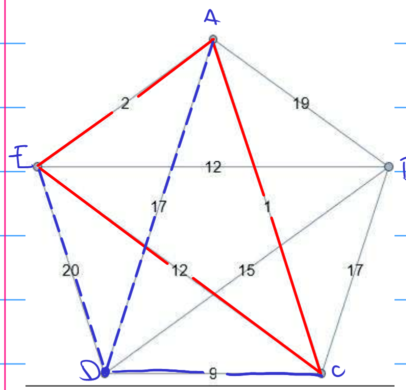
4.) ED'

5.) E'B



A' → A → C' → C → B' → B → E' → E → D' → D → A'

Nearest Insertion



1.) najkratšia hrana ⇒ AC

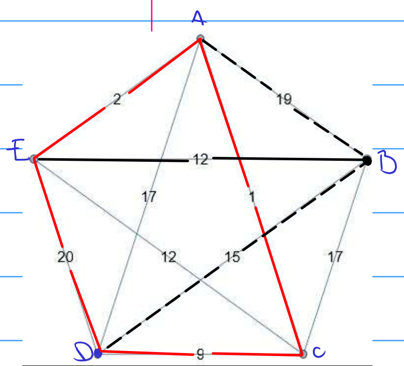
2.) najbližší bod ku AC je E

$\boxed{B}$ W(BA) = 19 $\boxed{D}$ W(DA) = 17

W(BC) = 17   W(DC) = 9

W(BE) = 12   W(DE) = 2

3.) Ďalšia hrana DC



4.) Mazanie hranu:

↳ W(DE) + W(DC) − W(CE) = 20 + 9 − 12 = 17

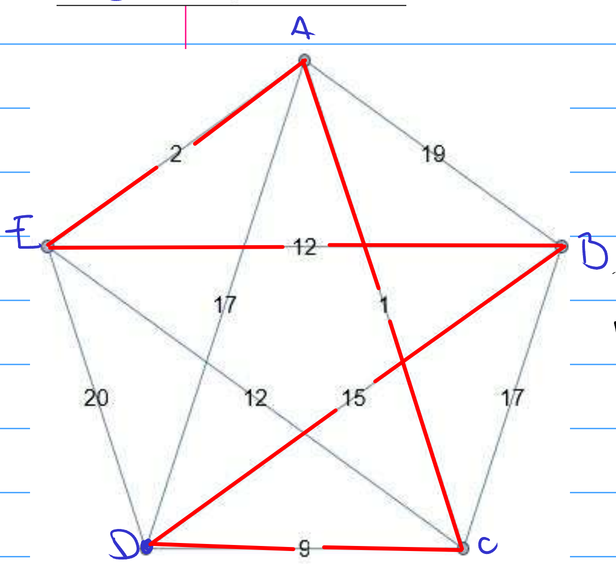
↳ W(CD) + W(DA) − W(CA) = 9 + 17 − 1 = 25

5.) Zostáva bod B

W(AB) = 19   W(DB) = 15

W(CB) = 17   W(BE) = 12

najbližší bod ⇒ E



6.) Mazanie:

↳ W(BE) + W(BA) − W(AE) = 12 + 19 − 2

↳ W(BE) + W(BD) − W(DE) = 12 + 15 − 20 = 7

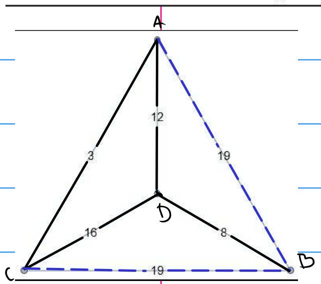
mažeme ED

ham. cycle: A → C → D → B → E → A

cena cesty: 1 + 9 + 15 + 12 + 2 = 39

ham. Path: B → E → A → C → D

Cena ham. Path = 12 + 2 + 1 + 9 = 24

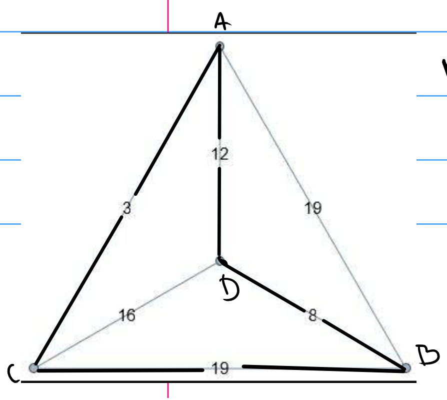


1.) Najkratšia hrana ⇒ AC

2.) Najbližší bod ku AC ⇒ D

3.) ostal bod B

W(BA) = 19, W(BD) = 8, W(BC) = 19



4.) Pridáme hranu BD   5.) Mazanie hranu

W(BD) + W(BA) − W(DA) = 8 + 19 − 12 = 15

W(BD) + W(BC) − W(CD) = 8 + 19 − 16 = 11

Mažeme CD, Pridáme BC

Cycle: B → D → A → C → B

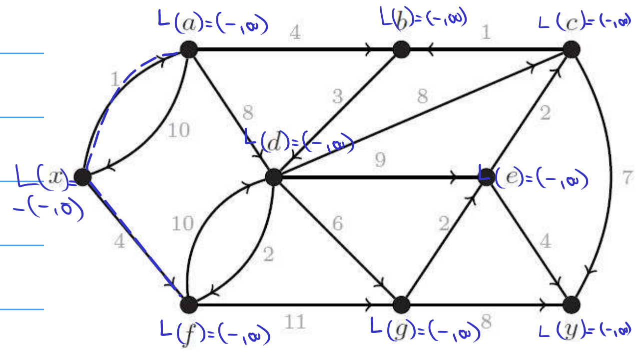
Path: B → D → A → C

Dikstrov algoritmus

Podmienky:

connected ✓ Váhovaný G ✓

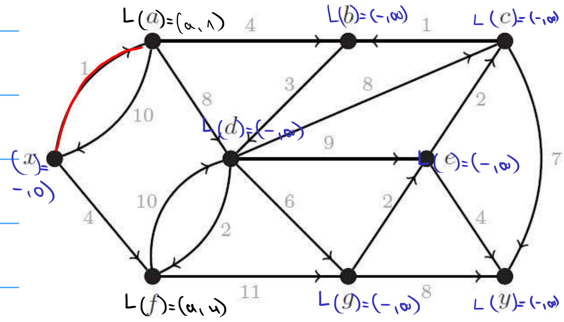
simple ✓



1.) F = {a, f}

W(x) + W(xa) = 0+1=1 < W(a) ✓

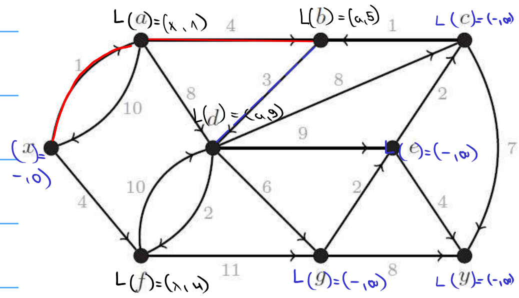
W(x) + W(xf) = 0+4=4 < W(f) ✓



2.) F = {b, d}

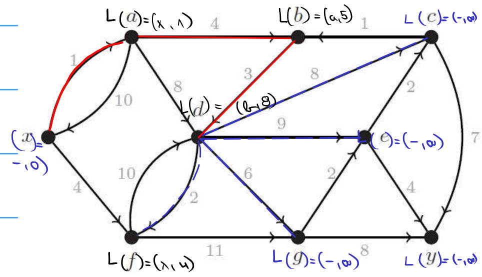
W(a) + W(ab) = 1+4=5 < W(b) ✓

W(a) + W(ad) = 1+8=9 < W(d) ✓



3.) F = {d}

W(b) + W(bd) = 5+3=8 < W(d) ✓



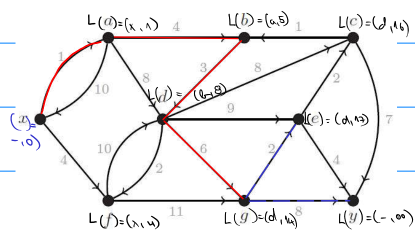
4.) F = {c, e, g, f}

W(d) + W(cd) = 8 + 8 = 16 < W(c)

W(d) + W(ed) = 8 + 9 = 17 < W(e)

W(d) + W(dg) = 8 + 6 = 14 < W(g)

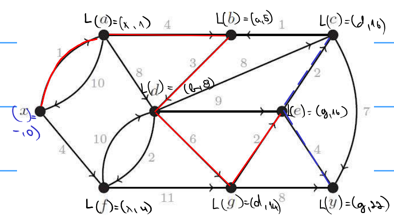
W(d) + W(df) = 8 + 2 = 10 > W(f)



5.) F = {e, y}

W(g) + W(eg) = 14 + 2 = 16 < W(g)

W(g) + W(yg) = 14 + 8 = 22 < W(y)

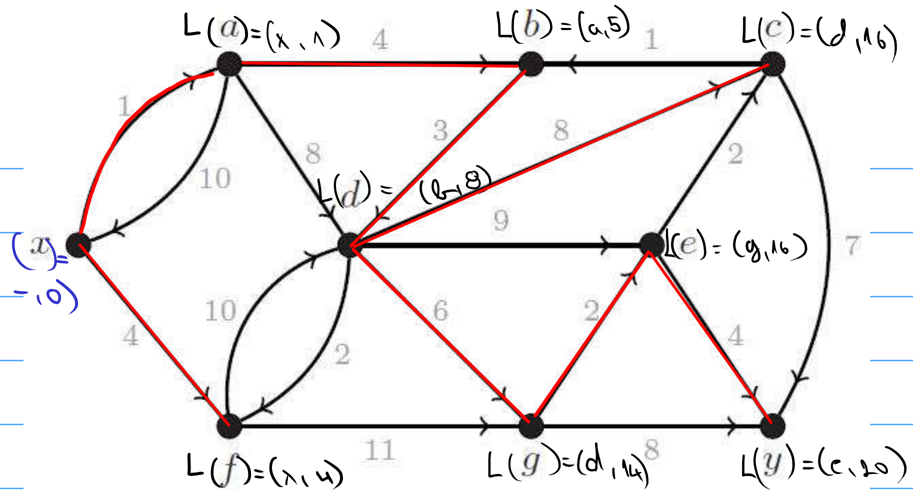


6.) F = {c, y}

W(e) + W(ce) = 16 + 2 = 18 = W(c)

W(e) + W(ye) = 16 + 4 = 20 < W(y)

X	O	-
a	1	x
b	5	a
c	16	d
d	8	b
E	16	g
f	4	x
g	14	d
y	20	e



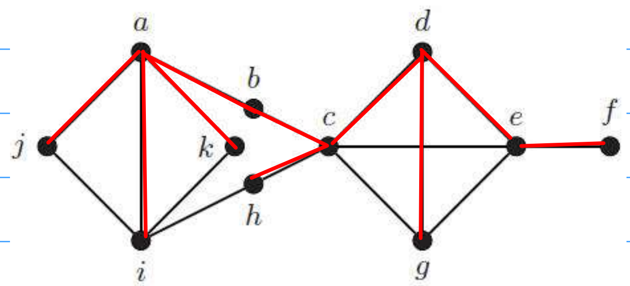
Spanning tree (kostra)

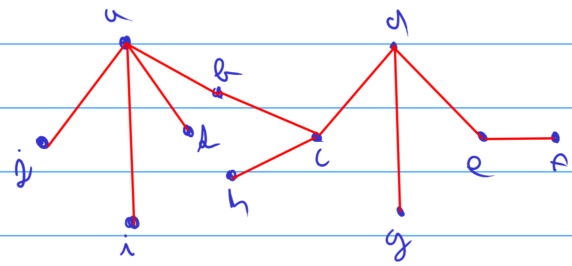
Strom (tree) => graf G musí byť
- acyklický
- connected

Les (Forest) => graf G musí byť
- acyklický
- nemusí byť connected

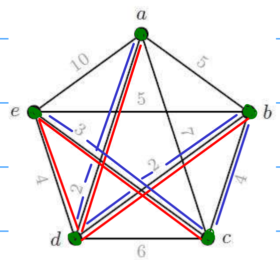
Vlastnosti stromov:

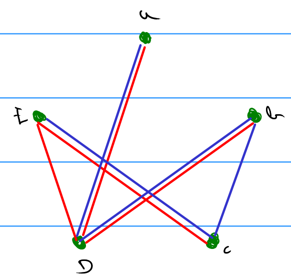
- $V(G) = n \wedge E(G) = n - 1$
- $\deg(V(G)) = 2n - 2$
- if connected $G \wedge V(G) = n \wedge E(G) = n - 1 \Rightarrow$ strom





Kruskal's Algoritam

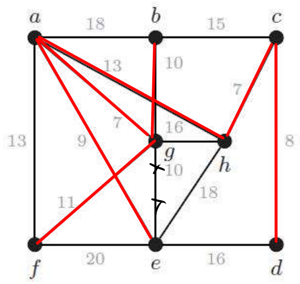




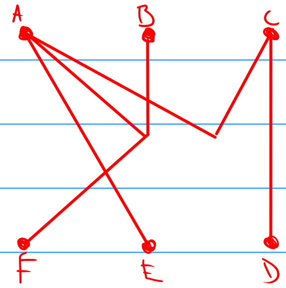
1.) AD
2.) DB
3.) CE
4.) DE

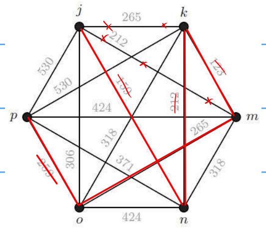
1.) AD
2.) DB
3.) CE
4.) BC

Kurkal's Algoritm

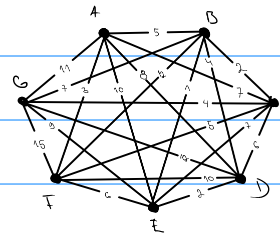


1.) CH
2.) AG
3.) CD
4.) AE
5.) ~~(EG)~~
6.) BG
7.) FG
8.) AH

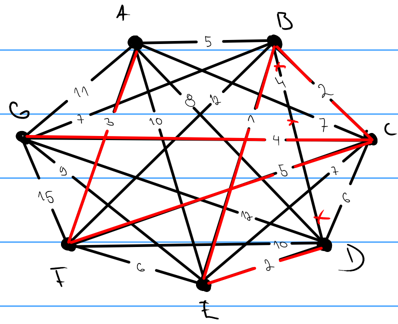




1.) km
2.) jn
3.) kn
4.) ~~(jm)~~
5.) po
6.) ~~(jk)~~
7.) mo



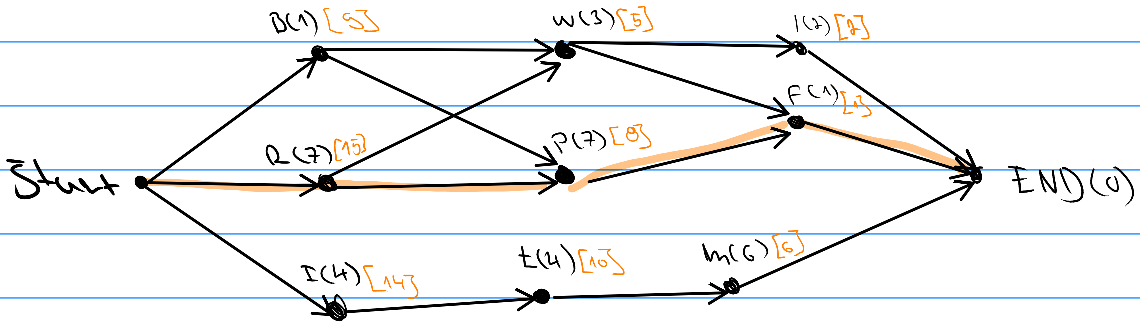
	a	b	c	d	e	f	g
a	·	5	7	8	10	3	11
b	5	·	2	~~4~~	1	12	7
c	7	2	·	6	7	5	4
d	8	4	6	·	2	10	12
e	10	1	7	2	·	6	9
f	3	12	5	10	6	·	15
g	11	7	4	12	9	15	·



1.) BE
2.) BC
3.) DE
4.) AF
5.) ~~(BD)~~
6.) CG
7.) spojenie AF so zvyškom
↳ najkratšie spojenie FC/AB
FC

Kritická cesta

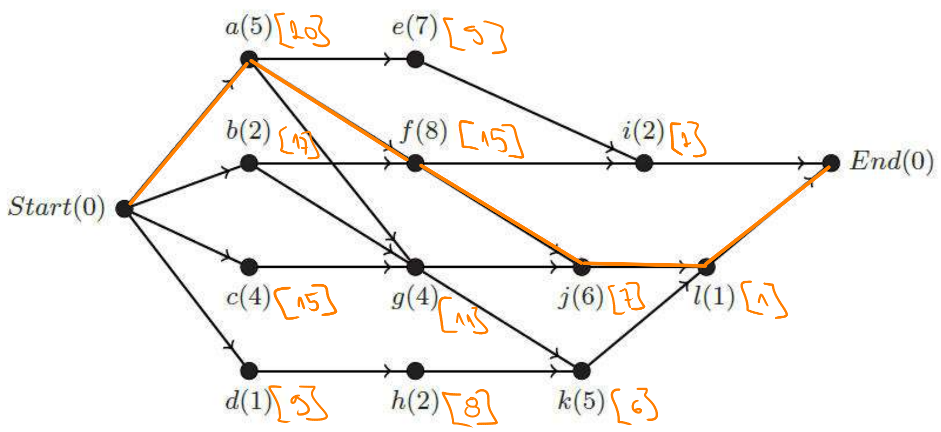
Task	Vertex Name	Processing Time	Precedence Relationships
Buy plants	b	1	
Remove bushes	r	7	
Remove ivy	i	4	
Weed flower beds	w	3	b, r
Plant bushes	p	7	b, r
Plant flowers	f	1	w, p
Trim trees	t	4	i
Mow and rake lawn	m	6	t
Install lighting	l	2	w



Najdlhšia cesta => Start -> R -> P -> F

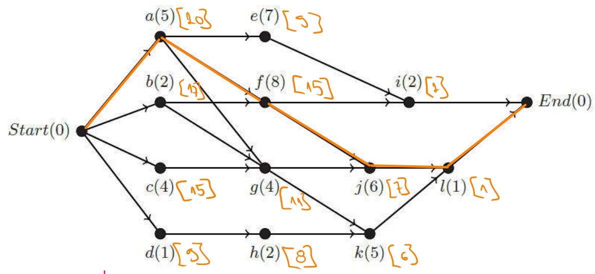
Zoradenie: R -> I -> t -> B -> P -> W -> m -> f -> L -> END

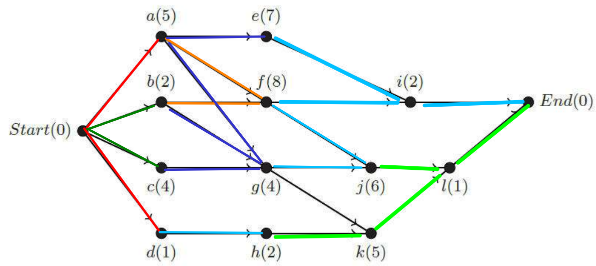
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
P1	R	R	R	R	R	R	R	B	P	P	P	P	P	P	P	F	l	l			
P2	I	I	I	I	t	t	t	t	W	W	W	m	m	m	m	m	m	*			



Najdlhšia trasa: Start -> A -> F -> J -> L -> END

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
P1	A	A	A	A	A	F	F	F	F	F	F	F	F	J	J	J	J	J	J	L	*	*	*	*	*	*	*			
P2	B	B	C	C	C	C	G	G	G	G	D	H	H	K	K	K	K	K	e	e	e	e	e	e	e	i	i			



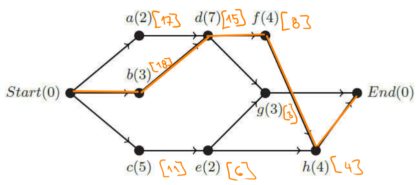


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
P1	A	A	A	A	A	D	F	F	F	F	F	F	F	F	H	H	J	J	J	J	J	J	i	i						
P2	B	B	C	C	C	C	G	G	G	G	E	E	E	E	E	E	E	K	K	K	K	K	L	*						

↳ Ušetril som 3 hod oboma procesorom A dalšie 2 zníži hod domu Proc

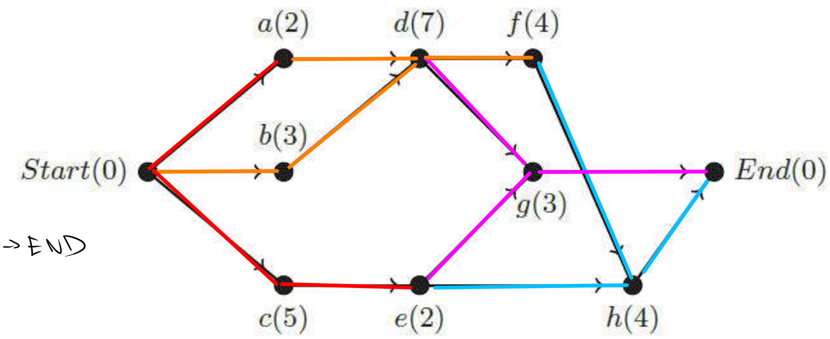
A -> D -> B -> C -> F -> G -> E -> H -> J -> K -> I -> END

Pr. 2.)

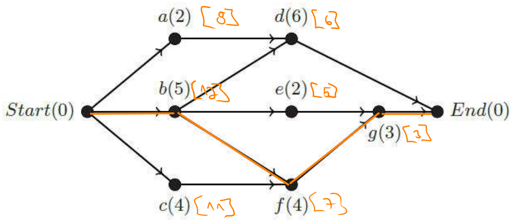


Start -> A -> D -> f -> H -> END

Zoznam: B -> A -> D -> C -> e -> F -> G -> H -> END



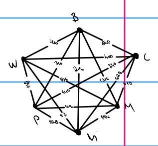
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
B	B	B	D	D	D	D	D	D	D	F	F	F	F	H	H	H	H												
A	A	C	C	C	C	C	e	e	*	G	G	G	*	*	*	*	*												

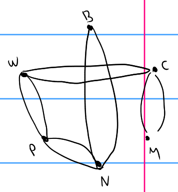


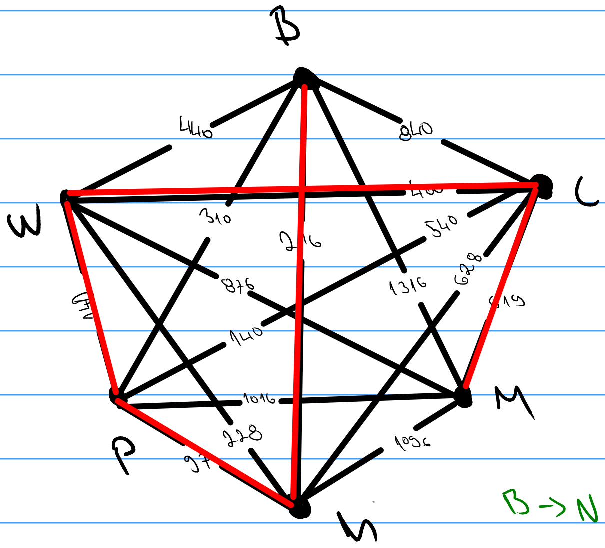
Start → B → F → G → END

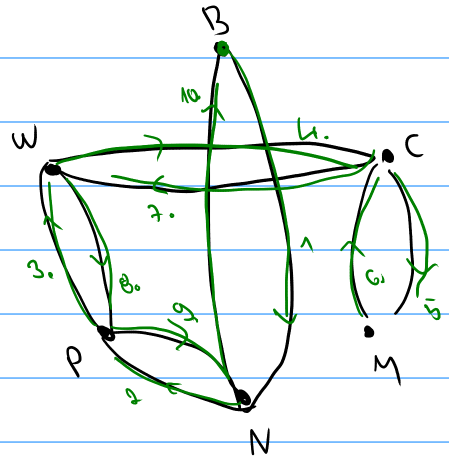
Zoznam: B → C → A → F → E → G → D

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
B	B	B	B	B	F	F	F	F	G	G	G																		
C	C	C	C	A	A	E	E	D	D	D	D	D	D																

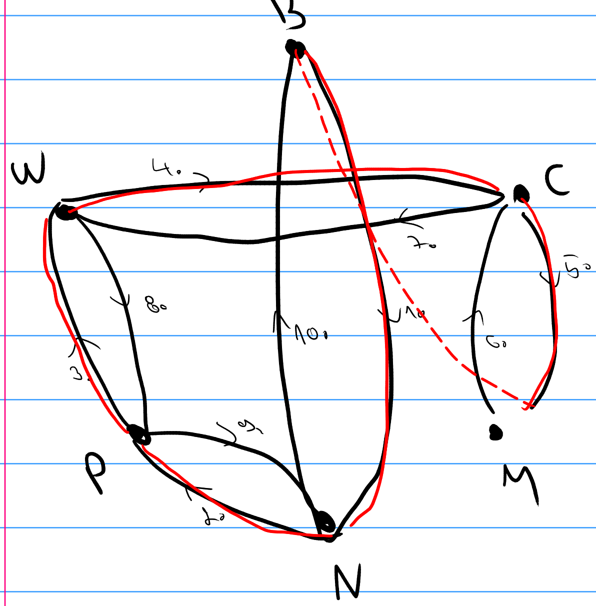








B → N → P → W → C → M → C → W → P → N → B



B N P W C B

216 + 97 + 140 + 400 + 619 + 1316