Graph Theory

Polytech Tours
2018-2019

Finishing the first part

- For `SearchChain_ts(`u_0`)` use the famillly of lists `_aprec`, `_bprec`, `_nprec`, `_asucc`, `_bsucc`, `_nsucc`

```
for j in succ[i]
        the_succ = j
```

```
for j in range(0,_asucc[i+1]-_asucc[i])
        the_succ = _bsucc[_asucc[i]+j]
        the_arc = _nsucc[_asucc[i]+j]
```

We have everything about this arc

- At the end of `SearchChain_ts(`u_0`)` we are supposed to know:
  - The list of arcs of the chain
  - The list of marked vertices

Finishing the first part

- Add the following lists:
  - `The_chain` will contain the chain
  - `mu_plus` will contain the arcs in the positive sense
  - `mu_minus` will contain the arcs in the negative sense

- Then, create a routine `IdentifyChain`(u_0) that will be called if there is a chain, and that will use `Predecessor` and `Successor` to create the list of arcs of the chain called `The_chain`

Similarly with Successor

```
Algorithm:
        dest = Origine[u0]
        orig = Destination[u0]
        i=dest
        While i ≠ orig Do
                if Predecessor[i] ≠ -1 then
                    • k = Predecessor[i]
                    • search the number
                of the arc (k,i) and
                add this arc to the
                list The_chain
                    • depending on the color
                of u0, add this arc to
                mu_plus or to mu_minus
                    • i = Predecessor[i]
```

TP n°2

I. Feasible flow

I. Graph reading & coding
II. Some routines
III. SearchChainColor(u_0) with colors
IV. Feasible flow

TP n°2

TP n°2

I. Graph reading & coding

TP n°2

I. Graph reading & coding

- A graph is described in a text file in a very simple way :

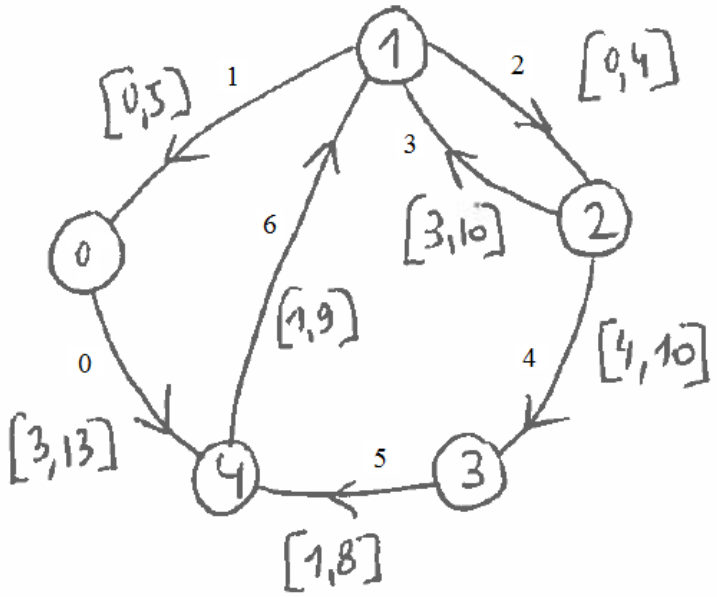
For all the arcs:

```
orig_v - tab - dest_v - tab - min_cap - tab - max_cap
```

graph_TP2.txt - Bloc-notes

Fichier Edition Format Affichage ?

0	4	3	13
1	0	0	5
1	2	0	4
2	1	3	10
2	3	4	10
3	4	1	8
4	1	1	9



TP n°2

I. Graph reading & coding

- 1st step
  - Open the file
  - Read the file
  - Close the file

```
# ############################
# Read the data
# ############################

file_graph = 'graph_TP1.txt'

# Format of the file:
# For each arc :
# origine_vertex - tab - destination_vertex - tab - min_capacity - tab - max_capacity - tab - cost

# Open the file - read - close the file
TheGraph = open(file_graph,"r")
all_arcs = TheGraph.readlines()
TheGraph.close()

print (all_arcs)
```

TP n°2

I. Graph reading & coding

- 2nd step
  - Code the graph
  - We have to read '**0**\t**1**\t**5**\t**12**\n'and to extract '**0**', '**1**', '**5**', and '**12**' ⇒ we use **split**
  - We have to delete '\n' ⇒ we use **strip**
- We define four lists of size M:
  - `Origine[`u`]` = vertex origine of arc u
  - `Destination`[u] = vertex destination of arc u
  - `MinCapacity[`u`]`
  - `MaxCapacity[`u]

```
# Fill the structures
Origine = []
Destination = []
MinCapacity = []
MaxCapacity = []
for one_arc in all_arcs:
    this_arc = one_arc.split("\t")
    orig = int(this_arc[0])
    dest = int(this_arc[1])
    mincap = int(this_arc[2])
    maxcap = int(this_arc[3].strip("\n"))
    Origine.append(orig)
    Destination.append(dest)
    MinCapacity.append(mincap)
    MaxCapacity.append(maxcap)

print('Origine=',Origine)
print('Destination=',Destination)
print('MinCapacity=',MinCapacity)
print('MaxCapacity=',MaxCapacity)
```

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I. Graph reading & coding

- For the graph structure, we keep:
  - Origine, Destination
  - prec, succ
  - a_prec, b_prec, n_prec, a_succ, b_succ, n_succ

- We introduce some lists
  - `Flow=[]` of size M that will contain the flows
  - `Color=[]` of size M that will contain the colors
  - `Distance=[]` of size M that will contain the distance of the arcs to the « feasibility »
  - `The_chain=[]` will contain the arcs of the chain/cycle

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II. Some routines

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II. Some routines

- First routine: `UpdateColor(u)` returns the color of arc u (according to the flow value, min and max capacities)

- Initialize the list `Color` by calling `UpdateColor()` M times

- Second routine: `TotalDistance()` returns the total distance of the flow to the feasibility (and update the `Distance[u]` for each arc).

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III. SearchChainColor(u_0)

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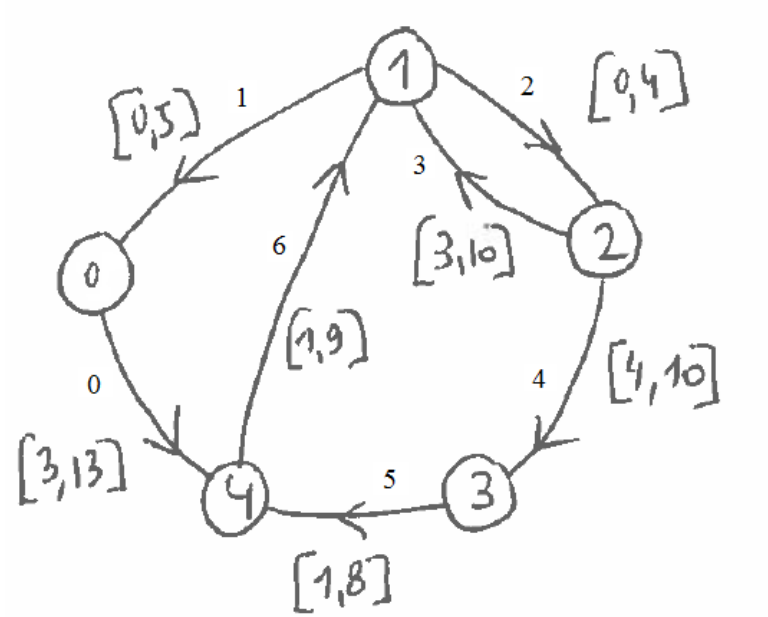
III. SearchChainColor(u_0)

- `SearchChainColor(`u_0`)`
  - is a routine searching for a chain from `Destination[`u_0`]` to `Origine[`u_0`]` with the black arcs in the same sense, the green arcs in the opposite sense, red arcs in an arbitrary sense and without uncolored arcs.



To check the color you need the number of the arc

Write the algorithm of `SearchChain_ts_Color`
Then, code it.
Give an arbitrary color to the arcs and test it

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IV. Feasible flow

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IV. Feasible flow: algorithm

- Boolean `feasible_flow` ← True
- While `TotalDistance()`>0 and `feasible_flow` Do
  - Search an arc u_0 with distance >0 (the arc with the maximum distance)
  - Initialized `Marked`, `Predecessor`, `Successor`, `The_chain` = []
  - If `SearchChainColor(`u_0`)`
    - Identify the chain (and μ^+ and μ^-), add u_0 to `The_chain` and to `mu_plus` or `mu_minus`
    - Compute `epsilon`
    - Modify the `Flow`
    - Update the Colors of the arcs in `The_chain`
  - Else
    - `Feasible_flow` ← False
  - Endif
- EndWhile

- Else
  - `Feasible_flow` ← False
  - Identify the Marked vertices (setA)
  - Identify $\omega^+(A)$ and $\omega^-(A)$
  - Show the inequality
- Endif