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lfauren / 03MAIR-Algoritmos-de-Optimizacion-2019

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Luis Fauré Navarro

AG3 - Actividad Guiada

https://github.com/lfauren/03MAIR-Algoritmos-de-Optimizacion-2019/tree/master/AG3

In [0]:
```
import urllib.request
file = "swiss42.tsp"
urllib.request.urlretrieve("http://elib.zib.de/pub/mp-testdata/tsp/tsplib/tsp/swiss42.tsp", fil
e)
```

Out[0]:
```
('swiss42.tsp', <http.client.HTTPMessage at 0x7ff43335e5f8>)
```

http://elib.zib.de/pub/mp-testdata/tsp/tsplib/tsp/swiss42.tsp Esta es la dirección del archivo "swiss42.tsp"

In [0]:
```
!pip install tsplib95
```

```
Requirement already satisfied: tsplib95 in /usr/local/lib/python3.6/dist-packages (0.3.2)
Requirement already satisfied: networkx==2.1 in /usr/local/lib/python3.6/dist-packages (from tsp
lib95) (2.1)
Requirement already satisfied: Click>=6.0 in /usr/local/lib/python3.6/dist-packages (from tsplib
95) (7.0)
Requirement already satisfied: decorator>=4.1.0 in /usr/local/lib/python3.6/dist-packages (from
networkx==2.1->tsplib95) (4.3.2)
```

In [0]:
```
import tsplib95
import random
from math import e

problem = tsplib95.load_problem(file)
#Nodos
Nodos = list(problem.get_nodes())
#Aristas
Aristas = list(problem.get_edges())
```

In [0]:
```
print('Nodos', Nodos)
print('Aristas', Aristas)
```

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```
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1, 37), (41, 38), (41, 39), (41, 40), (41, 41)]
```

In [0]:

```python
def factorial(n):
  if n == 0:
    return 1
  else:
    return n*factorial(n-1)

#Se genera una solucion aleatoria con comienzo en en el nodo 0
def crear_solucion(Nodos):
  solucion = [0]
  for i in range(len(Nodos)-1):
    solucion = solucion + [random.choice(list(set(Nodos) - set({0}) - set(solucion)))]
  return solucion

#Devuelve la distancia entre dos nodos
def distancia(a,b, problem):
  return problem.wfunc(a,b)

#Devuelve la distancia total de una trayectoria/solucion
def distancia_total(solucion, problem):
```

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```
  distancia_total = 0
  for i in range(len(solucion)-1):
    distancia_total += distancia(solucion[i] ,solucion[i+1] ,  problem)
  return distancia_total + distancia(solucion[len(solucion)-1] ,solucion[0], problem)

solucion = crear_solucion(Nodos)
distancia_total(solucion, problem)
```

Out[0]: 4584

In [0]:
```
def busqueda_aleatoria(problem, N):
  Nodos = list(problem.get_nodes())
  mejor_solucion = []
  mejor_distancia = 10e100
  for i in range(N):
    solucion = crear_solucion(Nodos)
    distancia = distancia_total(solucion, problem)
    if distancia < mejor_distancia:
      mejor_solucion = solucion
      mejor_distancia = distancia
  print("Mejor solución:" , mejor_solucion)
  print("Distancia     :" , mejor_distancia)
  return mejor_solucion

sol = busqueda_aleatoria(problem, 50000)
```

```
Mejor solución: [0, 14, 17, 20, 34, 40, 41, 16, 37, 22, 29, 3, 18, 4, 19, 5, 1, 24, 21, 38, 30,
9, 23, 32, 36, 7, 31, 8, 10, 25, 11, 28, 12, 13, 26, 33, 35, 39, 2, 15, 6, 27]
Distancia     : 3606
```

In [0]:
```
def genera_vecina(solucion):
  #Generador de soluciones vecinas: 2-opt (intercambiar 2 nodos) Si hay N nodos se generan (N-
1)x(N-2)/2 soluciones
  #print(solucion)
  mejor_solucion = []
  mejor_distancia = 10e100
  for i in range(1,len(solucion)-1):
    for j in range(i+1, len(solucion)):
      vecina = solucion[:i] + [solucion[j]] + solucion[i+1:j] + [solucion[i]] + solucion[j+1:]
      distancia_vecina = distancia_total(vecina, problem)
```

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```
      if distancia_vecina <= mejor_distancia:
        mejor_distancia = distancia_vecina
        mejor_solucion = vecina
  return mejor_solucion

solucion = crear_solucion(Nodos)
print(solucion)
nueva_solucion = genera_vecina(solucion)
print(nueva_solucion)
```

```
[0, 11, 26, 18, 29, 9, 31, 16, 34, 41, 15, 6, 10, 33, 39, 3, 21, 7, 32, 30, 17, 12, 25, 1, 19,
5, 35, 28, 20, 8, 40, 23, 13, 27, 38, 4, 2, 24, 37, 14, 22, 36]
[0, 11, 26, 18, 29, 9, 31, 16, 34, 41, 15, 6, 10, 33, 39, 24, 21, 7, 32, 30, 17, 12, 25, 1, 19,
5, 35, 28, 20, 8, 40, 23, 13, 27, 38, 4, 2, 3, 37, 14, 22, 36]
```

In [0]:
```
def busqueda_local(problem, N):
  mejor_solucion = []
  mejor_distancia = 10e100
  Nodos = list(problem.get_nodes())
  solucion_referencia = crear_solucion(Nodos)
  for i in range(N):
    vecina = genera_vecina(solucion_referencia)
    distancia_vecina = distancia_total(vecina, problem)
    if distancia_vecina < mejor_distancia:
      mejor_solucion = vecina
      mejor_distancia = distancia_vecina
    solucion_referencia = vecina
  print("Mejor solución:" , mejor_solucion)
  print("Distancia     :" , mejor_distancia)
  return mejor_solucion

sol = busqueda_local(problem, 100)
```

```
Mejor solución: [0, 32, 30, 38, 34, 33, 20, 15, 16, 14, 19, 13, 5, 8, 23, 41, 25, 11, 26, 6, 31,
35, 36, 17, 37, 7, 1, 3, 4, 18, 12, 10, 2, 28, 29, 22, 39, 21, 24, 40, 9, 27]
Distancia     : 1838
```

In [0]:
```
def genera_vecina_aleatorio(solucion):
  #Generador de 1 solucion vecina 2-opt (intercambiar 2 nodos)
  #Se puede mejorar haciendo que la elección no se uniforme sino entre las que estén más proxim
as
```

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```
as
  i = random.choice(range(1, len(solucion)) )
  j = random.choice(list(set(range(1, len(solucion))) - {i}))
  vecina = solucion[:i] + [solucion[j]] + solucion[i+1:j] + [solucion[i]] + solucion[j+1:]
  return vecina

def probabilidad(T,d):
  r=random.random();
  if(r <= (e**(-1*d)/(T*1.0))):
    return True
  else:
    return False

def bajar_temperatura(T):
  return T-1
```

In [0]:

```
def recocido_simulado(problem, TEMPERATURA):
  #problem = datos del problema
  #T = Temperatura
  solucion_referencia = crear_solucion(Nodos)
  distancia_referencia = distancia_total(solucion_referencia, problem)
  mejor_solucion = []
  mejor_distancia = 10e100
  while TEMPERATURA > 0:
    #Genera una solución vecina(aleatoria)
    vecina = genera_vecina(solucion_referencia)
    #Calcula su valor(distancia)
    distancia_vecina = distancia_total(vecina, problem)
    #Si es la mejor solución de todas se guarda
    if distancia_vecina < mejor_distancia:
        mejor_solucion = vecina
        mejor_distancia = distancia_vecina
    #Si la nueva vecina es mejor se cambia y si es peor se cambia según una probabilidad depend
iente de T y de |distancia_referencia - distancia_vecina|
    if distancia_vecina < distancia_referencia or probabilidad(TEMPERATURA, abs(distancia_refer
encia - distancia_vecina) ) :
      solucion_referencia = vecina
      distancia_referencia = distancia_vecina
    TEMPERATURA = bajar_temperatura(TEMPERATURA)
  print("La mejor solución encontrada es " , end="")
```

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```
  print(mejor_solucion)
  print("con una distancia total de " , end="")
  print(mejor_distancia)
  return mejor_solucion

sol = recocido_simulado(problem, 100)
```

```
La mejor solución encontrada es [0, 31, 17, 36, 35, 20, 33, 34, 32, 30, 29, 9, 40, 24, 21, 39, 2
2, 38, 23, 41, 25, 11, 12, 4, 3, 6, 5, 14, 15, 16, 19, 13, 26, 18, 10, 8, 28, 2, 27, 1, 37, 7]
con una distancia total de 1632
```

In [0]:
```
def Add_Nodo(problem, H ,T ) :
  #Establecer una una funcion de probabilidad para
  # añadir un nuevo nodo dependiendo de los nodos mas cercanos y de las feromonas depositadas
  Nodos = list(problem.get_nodes())
  return random.choice(   list(set(range(1,len(Nodos))) - set(H) )  )

def Incrementa_Feromona(problem, T, H ) :
  #Incrementar segun la calidad de la solución. Añadir una cantidad inversamente proporcional a
 la distancia total
  for i in range(len(H)-1):
    T[H[i]][H[i+1]] += 1000/distancia_total(H, problem)
  return T

def Evaporar_Feromonas(T ):
  #Podemos elegir diferentes funciones de evaporación dependiendo de la cantidad actual y de la
 suma total de feromonas depositadas,...
  #Evapora 0.3 el valor de la feromona, sin que baje de 1
  T = [[ max(T[i][j] - 0.3 , 1) for i in range(len(Nodos)) ] for j in range(len(Nodos))]
  return T
```

In [0]:
```
def hormigas(problem, N) :
  #problem = datos del problema
  #N = Número de agentes(hormigas)
  #Nodos
  Nodos = list(problem.get_nodes())
    #Aristas
  Aristas = list(problem.get_edges())
  #Inicializa las aristas con una cantidad inicial de feromonas:1
  T = [[ 1 for   in range(len(Nodos)) ] for   in range(len(Nodos))]
```

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```
  #Se generan los agentes(hormigas) que serán estructuras de caminos desde 0
  Hormiga = [[0] for _ in range(N)]
  #Recorre cada agente construyendo la solución
  for h in range(N) :
    #print("\nAgente:", h)
    #Para cada agente se construye un camino
    for i in range(len(Nodos)-1) :
      #Elige el siguiente nodo
      Nuevo_Nodo = Add_Nodo(problem, Hormiga[h] ,T )
      Hormiga[h].append(Nuevo_Nodo)
    #Incrementa feromonas en esa arista
    T = Incrementa_Feromona(problem, T, Hormiga[h] )
    #print("Feromonas(1)", T)
    #Evapora Feromonas
    T = Evaporar_Feromonas(T)
    #print("Feromonas(2)", T)
  #Seleccionamos el mejor agente
  mejor_solucion = []
  mejor_distancia = 10e100
  for h in range(N) :
    distancia_actual = distancia_total(Hormiga[h], problem)
    if distancia_actual < mejor_distancia:
      mejor_solucion = Hormiga[h]
      mejor_distancia =distancia_actual
  print(mejor_solucion)
  print(mejor_distancia)

hormigas(problem, 1000)
```

```
[0, 18, 9, 13, 32, 11, 15, 36, 20, 29, 30, 35, 34, 1, 27, 2, 41, 16, 31, 19, 26, 14, 7, 28, 12,
10, 25, 4, 5, 6, 40, 8, 23, 22, 38, 17, 37, 33, 3, 24, 21, 39]
3763
```

In [0]:

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