Branch: master ▾ 03MAIR-Algoritmos-de-optimizacion / AG3 / Isabel_Vazquez_AG3.ipynb

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AG-Actividad Guiada 3

Nombre: Isabel Vázquez Trigás

https://github.com/404isabel/03MAIR-Algoritmos-de-optimizacion/tree/master/AG3

In [13]:
```
import urllib.request
file="swiss42.tsp"
urllib.request.urlretrieve("http://elib.zib.de/pub/mp-testdata/tsp/tsplib/tsp/swiss42.tsp",file
)
```

Out[13]:
```
('swiss42.tsp', <http.client.HTTPMessage at 0x7fd51edc0898>)
```

In [11]:
```
!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())

#print("Nodos",Nodos)
```

In [15]:
```
print("Nodos",Nodos)
print("Aristas",Aristas)
```

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

In [0]:
```python
#Devuelve el factorial de un numero
def factorial(n):
    if n == 0:
        return 1
    else:
        return n * factorial(n-1)
```

In [43]:
```python
#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)

#distancia(0,1,problem)

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

Out[43]: 4582

In [84]:
```
def busquedaAleatoria(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("Mejor distancia :",mejor_distancia)

  return mejor_solucion


sol=busquedaAleatoria(problem, 10)
```

```
Mejor solución : [0, 13, 10, 21, 35, 38, 9, 39, 16, 40, 8, 12, 33, 34, 15, 24, 18, 11, 7, 31, 3
7, 14, 2, 28, 27, 22, 41, 17, 5, 1, 4, 23, 30, 29, 20, 36, 6, 3, 32, 25, 26, 19]
Mejor distancia : 4329
```

In [85]:
```
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)
      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) #Se ve cómo se han intercambiado 2 nodos
print(nueva_solucion)
```

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

In [86]:
```
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)
    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("Mejor distancia:",mejor_distancia)

  return mejor_solucion



  #print(solucion_referencia)

sol=busqueda_local(problem,10)
```

```
Mejor solución: [0, 5, 10, 19, 8, 4, 15, 14, 26, 32, 36, 1, 20, 33, 28, 3, 6, 18, 11, 25, 27, 4
1, 12, 37, 29, 9, 17, 16, 7, 23, 2, 22, 38, 40, 24, 31, 35, 21, 30, 13, 39, 34]
Mejor distancia: 4058
```

In [0]:
```
#No mejora el algoritmo anterior
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
  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()
  return r <= (e**(-1*d)/(T*1.0))
  #if(r <= (e**(-1*d)/(T*1.0))):
  #  return True
  #else:
  #  return False

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

In [89]:
```
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_aleatorio(solucion_referencia)
    #vecina = genera_vecina(solucion_referencia)#Mejores soluciones

    #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 depen
diente 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="")
  print(mejor_solucion)
  print("con una distancia total de " , end="")
  print(mejor_distancia)
  return mejor_solucion

sol = recocido_simulado(problem, 10000)
```

```
La mejor solución encontrada es [0, 1, 3, 4, 8, 10, 11, 25, 9, 29, 30, 28, 27, 2, 39, 21, 24, 4
0, 23, 41, 12, 18, 26, 5, 15, 37, 17, 31, 36, 35, 20, 33, 34, 38, 22, 32, 6, 13, 19, 16, 14, 7]
con una distancia total de 1722
```

In [0]:
```
#Colonia de hormigas
def Add_Nodo(problem, H ,T ) : #H (hormiga):recorrido parcial T:fermomona ---> mejorar este mét
odo, no se está teniendo en cuenta T (jugar con los dos parámetros, distancia y feromona)
  #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) )  ) #añade un nodo de modo al
eatorio, debería ser en base a la feromona T


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) #más feromonas a las distancias más peq
ueñas
  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    --> mejorable, podría hacerse en b
ase al número de ciclos, etc...
  T = [[ max(T[i][j] - 0.3 , 1) for i in range(len(Nodos)) ] for j in range(len(Nodos))]
```

```
  return T
```

In [91]:
```
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))]

  #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):
```

```
  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, 35, 32, 22, 11, 17, 19, 5, 8, 4, 2, 34, 20, 26, 37, 36, 10, 41, 23, 3, 6, 15, 27, 29, 21, 1
2, 25, 16, 14, 39, 40, 24, 28, 9, 38, 31, 33, 13, 30, 7, 1, 18]
3922
```

In [0]: