Concurrent programming lab04 - simon.barras

5.5

```python
  1: #!/usr/bin/env python3
  2: # -*- coding: utf-8 -*-
  3:
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 13: # distributed under the License is distributed on an "AS IS" BASIS,
 14: # WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 15: # See the License for the specific language governing permissions and
 16: # limitations under the License.
 17:
 18: """Monitor and cars for the one-lane monitor"""
 19:
 20: __author__ = "Simon Barras"
 21: __date__ = "2021-12-07"
 22: __version__ = "0.0.1"
 23: __email__ = "simon.barras@edu.hefr.ch"
 24: __userid__ = "simon.barras"
 25:
 26: #### Import ####
 27: from threading import Condition  # Condition for the monitor
 28: from threading import Lock       # Lock for the monitor
 29: from threading import Thread     # threads
 30: from threading import Event      # Event for wait
 31: import random as rnd             # lib for random number
 32: import logging                   # print the log thread safe
 33:
 34:
 35: #### CONSTANTS ####
 36: MAX_SPEED_CAR = 10              # Max time car character
 37: MAX_SPEED = 50 - MAX_SPEED_CAR  # Max time
 38: MILLISECONDS = 1000            # Number of milliseconds in a second
 39:
 40:
 41: # initialization of the class and the monitor with default values
 42: class TunnelMonitor:
 43:     """The tunnel monitor"""
 44:
 45:     monitor_lock: Lock          # lock for the monitor
 46:     north_condition: Condition  # Catch the north car
 47:     south_condition: Condition  # Catch the south car
 48:     limit: int                  # limit of car in a row before a change
 49:     limit_north: int            # limit of car of north
 50:     limit_south: int            # limit of car of south
 51:     counter_north: int          # count the number of north car in the tunnel
 52:     counter_south: int          # count the number of south car in the tunnel
 53:     nb_cars_north: int          # count the number of north waiting car
 54:     nb_cars_south: int          # count the number of south waitting car
 55:
 56:     # initialize the tunnel monitor , with the limit
 57:     def __init__(self, limit):
 58:         self.monitor_lock = Lock()
 59:         self.wait_north = Condition(self.monitor_lock)  # some magical CV
 60:         self.wait_south = Condition(self.monitor_lock)  # some magical CV
 61:
 62:         self.limit = limit
 63:         self.limit_north = limit
 64:         self.limit_south = limit
 65:         self.counter_north = 0
 66:         self.counter_south = 0
 67:         self.nb_cars_north = 0
 68:         self.nb_cars_south = 0
 69:
 70:     # call by car entering on the north side
 71:     def enter_north(self):
 72:         with self.monitor_lock:
 73:             logging.debug(
 74:                 f"""Enter north\n
 75:                 \t north {self.nb_cars_north}, counter {self.counter_north}, limit {self.limit_north}\n
 76:                 \t south {self.nb_cars_south}, counter {self.counter_south}, limit {self.limit_south}""")
 77:             self.nb_cars_north += 1
 78:             while self.counter_south > 0 or self.limit_north <= 0:
 79:                 self.wait_north.wait()
 80:                 logging.debug(
 81:                     f"""wake up north\n
 82:                     \t north {self.nb_cars_north}, counter {self.counter_north}, limit {self.limit_north}\n
 83:                     \t south {self.nb_cars_south}, counter {self.counter_south}, limit {self.limit_south}""")
 84:
 85:             self.limit_south = self.limit
 86:             self.counter_north += 1
 87:             self.nb_cars_north -= 1
 88:             if self.nb_cars_south > 0:
 89:                 self.limit_north -= 1
 90:             else:
 91:                 self.wait_north.notifyAll()
 92:
 93:     # call by car entering on the south side
 94:     def enter_south(self):
 95:         with self.monitor_lock:
 96:             logging.debug(
```

```
 97:                    f"""Enter south\n
 98:                    \t north {self.nb_cars_north}, counter {self.counter_north}, limit {self.limit_north}\n
 99:                    \t south {self.nb_cars_south}, counter {self.counter_south}, limit {self.limit_south}""")
100:                self.nb_cars_south += 1
101:                while self.counter_north > 0 or self.limit_south <= 0:
102:                    self.wait_south.wait()
103:                    logging.debug(
104:                        f"""wake up south\n
105:                        \t north {self.nb_cars_north}, counter {self.counter_north}, limit {self.limit_north}\n
106:                        \t south {self.nb_cars_south}, counter {self.counter_south}, limit {self.limit_south}""")
107:
108:                self.limit_north = self.limit
109:                self.counter_south += 1
110:                self.nb_cars_south -= 1
111:                if self.nb_cars_north > 0:
112:                    self.limit_south -= 1
113:                else:
114:                    self.wait_south.notifyAll()
115:
116:        # call by car exiting on the south side
117:        def exit_north(self):
118:            with self.monitor_lock:
119:                logging.debug(
120:                    f"""Exit north\n
121:                    \t north {self.nb_cars_north}, counter {self.counter_north}, limit {self.limit_north}\n
122:                    \t south {self.nb_cars_south}, counter {self.counter_south}, limit {self.limit_south}""")
123:                self.counter_north -= 1
124:                for _ in range(self.limit):
125:                    self.wait_south.notify()                SC
126:
127:        # call by car exiting on the north side
128:        def exit_south(self):
129:            with self.monitor_lock:
130:                logging.debug(
131:                    f"""Exit south\n
132:                    \t north {self.nb_cars_north}, counter {self.counter_north}, limit {self.limit_north}\n
133:                    \t south {self.nb_cars_south}, counter {self.counter_south}, limit {self.limit_south}""")
134:                self.counter_south -= 1
135:                for _ in range(self.limit):
136:                    self.wait_north.notify()             SC
137:
138:
139: class Vehicle:
140:     """
141:     Simulate a car
142:     """
143:
144:     motor: Thread              # Thread of the cars
145:     north: bool                # is the car going to the north
146:     tunnel: TunnelMonitor   # the tunnel
147:     name: str                  # name of the car
148:     speed: int                 # speed of the car
149:
150:     def __init__(self, cycle: int, north: bool, tunnel: TunnelMonitor, name: str = ""):
151:         self.north = north
152:         self.motor = Thread(target=self.drive, args=(cycle,))
153:         self.tunnel = tunnel
154:         self.name = name
155:         self.speed = rnd.randrange(MAX_SPEED_CAR)
156:
157:     # Start the thread
158:     def jump_in_car(self):
159:         logging.info("{} is jumping in the car".format(self.name))
160:         self.motor.start()
161:
162:     # Routine of the thread
163:     def drive(self, cycle: int):
164:         nap(self.speed)
165:         for _ in range(cycle):
166:             self.drive_to_tunnel_entrance()
167:             self.wait_for_entrance_permission()
168:             self.drive_though_tunnel()
169:             self.exit_tunnel()
170:             self.drive_to_origin()
171:
172:     # Random timer
173:     def drive_to_tunnel_entrance(self):
174:         logging.info("{} is going to the tunnel entrance".format(self.name))
175:         nap(self.speed)
176:
177:     # Wait until the tunnel is open
178:     def wait_for_entrance_permission(self):
179:         logging.info("{} is waiting for the entrance permission".format(self.name))
180:         if self.north:
181:             self.tunnel.enter_north()
182:         else:
183:             self.tunnel.enter_south()
184:
185:     # Random timer
186:     def drive_though_tunnel(self):
187:         logging.info("{} is driving through the tunnel".format(self.name))
188:         nap(self.speed)
189:
190:     # Leave the tunnel
191:     def exit_tunnel(self):
192:         logging.info("{} is leaving the tunnel".format(self.name))
```

```
193:              if self.north:
194:                  self.tunnel.exit_north()
195:              else:
196:                  self.tunnel.exit_south()
197:
198:          # Go to origin postion, random timer
199:          def drive_to_origin(self):
200:              logging.info("{} is going back to the origin".format(self.name))
201:              nap(self.speed)
202:
203:          # kill the thread
204:          def get_out_of_car(self):
205:              self.motor.join()
206:              logging.info("{} is getting out of the car".format(self.name))
207:
208:
209:  # Random timer
210:  def nap(time: int):
211:      wait_time = time + rnd.randrange(MAX_SPEED)
212:      Event().wait(wait_time / MILLISECONDS)
```

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 17:
 18:
 19: """
 20: Test the bird simulation
 21: """
 22:
 23: __author__ = "Simon Barras"
 24: __date__ = "2021-12-03"
 25: __version__ = "0.1.0"
 26: __email__ = "simon.barras@edu.hefr.ch"
 27: __userid__ = "simon.barras"
 28:
 29:
 30: import os  # call the file
 31:
 32: # Constants
 33: SOURCE_PATH = ".\\lab04\\src"
 34: FILE_NAME = "tunnel.py"
 35: PYTHON = "C:/Users/simon/Envs/concurp/Scripts/python.exe"
 36:
 37: # Global variables
 38: g_nb_north = 29
 39: g_cycle_north = 23
 40: g_nb_south = 31
 41: g_cycle_south = 19
 42: g_limit = 5
 43:
 44:
 45: # Move working directory
 46: os.chdir(SOURCE_PATH)
 47:
 48:
 49: # Run
 50: def run(*args):
 51:     command = f"{PYTHON} {FILE_NAME} {' '.join(args)}"
 52:     print(command)
 53:     result = os.system(command)
 54:     print("exit code: {}".format(result))
 55:     return 0 == result
 56:
 57:
 58: # test if not int number of north car's argument is correctly interpreted
 59: def test_not_int_cars_north():
 60:     assert(not run("-N dix"))
 61:     assert(not run("-N 10dix"))
 62:     assert(not run("-N 10.5"))
 63:
 64:
 65: # test if not int number of south car's argument is correctly interpreted
 66: def test_not_int_cars_south():
 67:     assert(not run("-S dix"))
 68:     assert(not run("-S 10dix"))
 69:     assert(not run("-S 10.5"))
 70:
 71:
 72: # test if not int number of north cycle's argument is correctly interpreted
 73: def test_not_int_cycle_north():
 74:     assert(not run("-n dix"))
 75:     assert(not run("-n 10dix"))
 76:     assert(not run("-n 10.5"))
 77:
 78:
 79: # test if not int number of south cycle's argument is correctly interpreted
 80: def test_not_int_cycle_south():
 81:     assert(not run("-s dix"))
 82:     assert(not run("-s 10dix"))
 83:     assert(not run("-s 10.5"))
 84:
 85:
 86: # test if not int limit's argument is correctly interpreted
 87: def test_not_int_limit():
 88:     assert(not run("-L dix"))
 89:     assert(not run("-L 10dix"))
 90:     assert(not run("-L 10.5"))
 91:
 92:
 93: # test bounds of the number of north car's argument
 94: def test_bound_north_car():
 95:     assert(not run("-N -1"))
 96:     assert(run("-N 0"))
```

```
 97:        assert(run("-N 1"))
 98:
 99:
100: # test bounds of the number of south car's argument
101: def test_bound_south_car():
102:        assert(not run("-S -1"))
103:        assert(run("-S 0"))
104:        assert(run("-S 1"))
105:
106:
107: # test bounds of the cycle of north car's argument
108: def test_bound_north_cycle():
109:        assert(not run("-n -1"))
110:        assert(not run("-n 0"))
111:        assert(run("-n 1"))
112:
113:
114: # test bounds of the cycle of south car's argument
115: def test_bound_south_cycle():
116:        assert(not run("-n -1"))
117:        assert(not run("-n 0"))
118:        assert(run("-n 1"))
119:
120:
121: # test bounds of the limit's argument
122: def test_bound_limit():
123:        assert(not run("-n -1"))
124:        assert(not run("-n 0"))
125:        assert(run("-n 1"))
126:
127:
128: # test different number of arguments
129: def test_nb_argument():
130:        assert(run())
131:        assert(run("-N 5"))
132:        assert(run("-N 5 -S 5"))
133:        assert(run("-N 5 -S 5 -n 5"))
134:        assert(run("-N 5 -S 5 -n 5 -s 5"))
135:        assert(run("-N 5 -S 5 -n 5 -s 5 -L 5"))
136:        assert(run("-N 5 -S 5 -n 5 -L 5"))
137:        assert(run("-N 5 -S 5 -n 5 -L 5 -s 5"))
138:        assert(run("-N 5 -S 5 -s 5"))
139:        assert(run("-N 5 -S 5 -s 5 -n 5"))
140:        assert(run("-N 5 -S 5 -s 5 -n 5 -L 5"))
141:        assert(run("-N 5 -S 5 -s 5 -L 5"))
142:        assert(run("-N 5 -S 5 -s 5 -L 5 -n 5"))
143:        assert(run("-N 5 -S 5 -L 5"))
144:        assert(run("-N 5 -S 5 -L 5 -n 5"))
145:        assert(run("-N 5 -S 5 -L 5 -n 5 -s 5"))
146:        assert(run("-N 5 -S 5 -L 5 -s 5"))
147:        assert(run("-N 5 -S 5 -L 5 -s 5 -n 5"))
148:        assert(run("-N 5 -n 5"))
149:        assert(run("-N 5 -n 5 -S 5"))
150:        assert(run("-N 5 -n 5 -S 5 -s 5"))
151:        assert(run("-N 5 -n 5 -S 5 -s 5 -L 5"))
152:        assert(run("-N 5 -n 5 -S 5 -L 5 -s 5"))
153:        assert(run("-N 5 -n 5 -s 5"))
154:        assert(run("-N 5 -n 5 -s 5 -S 5"))
155:        assert(run("-N 5 -n 5 -s 5 -S 5 -L 5"))
156:        assert(run("-N 5 -n 5 -s 5 -L 5"))
157:        assert(run("-N 5 -n 5 -s 5 -L 5 -S 5"))
158:        assert(run("-N 5 -n 5 -L 5"))
159:        assert(run("-N 5 -n 5 -L 5 -S 5"))
160:        assert(run("-N 5 -n 5 -L 5 -S 5 -s 5"))
161:        assert(run("-N 5 -n 5 -L 5 -s 5"))
162:        assert(run("-N 5 -n 5 -L 5 -s 5 -S 5"))
163:        assert(run("-N 5 -s 5"))
164:        assert(run("-N 5 -s 5 -S 5"))
165:        assert(run("-N 5 -s 5 -S 5 -n 5"))
166:        assert(run("-N 5 -s 5 -S 5 -n 5 -L 5"))
167:        assert(run("-N 5 -s 5 -S 5 -L 5"))
168:        assert(run("-N 5 -s 5 -S 5 -L 5 -n 5"))
169:        assert(run("-N 5 -s 5 -n 5"))
170:        assert(run("-N 5 -s 5 -n 5 -S 5"))
171:        assert(run("-N 5 -s 5 -n 5 -S 5 -L 5"))
172:        assert(run("-N 5 -s 5 -n 5 -L 5"))
173:        assert(run("-N 5 -s 5 -n 5 -L 5 -S 5"))
174:        assert(run("-N 5 -s 5 -L 5"))
175:        assert(run("-N 5 -s 5 -L 5 -S 5"))
176:        assert(run("-N 5 -s 5 -L 5 -S 5 -n 5"))
177:        assert(run("-N 5 -s 5 -L 5 -n 5"))
178:        assert(run("-N 5 -s 5 -L 5 -n 5 -S 5"))
179:        assert(run("-N 5 -L 5"))
180:        assert(run("-N 5 -L 5 -S 5"))
181:        assert(run("-N 5 -L 5 -S 5 -n 5"))
182:        assert(run("-N 5 -L 5 -S 5 -n 5 -s 5"))
183:        assert(run("-N 5 -L 5 -S 5 -s 5"))
184:        assert(run("-N 5 -L 5 -S 5 -s 5 -n 5"))
185:        assert(run("-N 5 -L 5 -n 5"))
186:        assert(run("-N 5 -L 5 -n 5 -S 5"))
187:        assert(run("-N 5 -L 5 -n 5 -S 5 -s 5"))
188:        assert(run("-N 5 -L 5 -n 5 -s 5 -S 5"))
189:        assert(run("-N 5 -L 5 -s 5"))
190:        assert(run("-N 5 -L 5 -s 5 -S 5"))
191:        assert(run("-N 5 -L 5 -s 5 -S 5 -n 5"))
192:        assert(run("-N 5 -L 5 -s 5 -n 5"))
```

```
193:        assert(run("-N 5 -L 5 -s 5 -n 5 -S 5"))
194:
195:
196: # test with big arguments
197: def test_big():
198:        assert(run("-N 1000 -S 1000 -n 1000 -s 1000 -L 1000"))
199:
200:
201: # the big boss of tests
202: def test_life():
203:        assert(run("-N 42", "-n 42", "-S 42", "-s 42", "-L 42"))
204:
205:
206: if __name__ == "__main__":
207:        test_life()
```

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15: # See the License for the specific language governing permissions and
16: # limitations under the License.
17:
18: """
19: Simulation of a one-lane tunnel.
20: """
21:
22: __author__ = "Simon Barras"
23: __date__ = "2021-12-07"
24: __version__ = "0.0.1"
25: __email__ = "simon.barras@edu.hefr.ch"
26: __userid__ = "simon.barras"
27:
28:
29: #### Import ####
30: from TunnelMonitor import TunnelMonitor   # my monitor for the threads
31: from TunnelMonitor import Vehicle         # Class that simulate the cars
32: import logging                            # print log in console with information of the thread
33: import argparse                           # parser for paramaters
34: import sys                                # Work with the computer
35:
36:
37: #### DEFAULT ####
38: CAR_NORTH = 29     # number of cars going north
39: CAR_SOUTH = 31     # number of cars going south
40: CYCLE_NORTH = 23   # number of time a car is going north
41: CYCLE_SOUTH = 19   # number of time a car is going south
42: LIMIT = 5          # Max number of cars going in the same direction
43:
44:
45: #### Methods ####
46:
47: # Main method. Life cycle of the app
48: def main(car_north, car_south, cycle_north, cycle_south, limit):
49:     print("Lab04 - The one-lane tunnel simulation")
50:     print("{} cars going north, {} cars going south, {} cycles north, {} cycles south, limit {}".format(
51:         car_north, car_south, cycle_north, cycle_south, limit))
52:     tunnel_monitor = TunnelMonitor(limit)
53:     print(tunnel_monitor.__doc__)
54:
55:     cars = []
56:
57:     for i in range(car_north):
58:         cars.append(Vehicle(cycle_north, True, tunnel_monitor, "North: {}".format(i)))
59:     for i in range(car_south):
60:         cars.append(Vehicle(cycle_south, False, tunnel_monitor, "South: {}".format(i)))
61:
62:     for car in cars:
63:         car.jump_in_car()
64:
65:     for car in cars:
66:         car.get_out_of_car()
67:
68:
69: # Format args
70: class CAR_ACTION(argparse.Action):
71:     """
72:     Check if the number of cars is a positive integer
73:     """
74:
75:     def __call__(self, parser, namespace, values, option_string=None):
76:         if values < 0:
77:             parser.error("The number of cars must be a positive integer")
78:         setattr(namespace, self.dest, values)
79:
80:
81: class CYCLE_ACTION(argparse.Action):
82:     """
83:     Check if the number of cycles is a positive integer
84:     """
85:
86:     def __call__(self, parser, namespace, values, option_string=None):
87:         if values <= 0:
88:             parser.error("The number of cycles must be a positive integer")
89:         setattr(namespace, self.dest, values)
90:
91:
92: class LIMIT_ACTION(argparse.Action):
93:     """
94:     Check if the number of cars is a positive integer
95:     """
96:
```

(handwritten annotations) thread start / thread join

(handwritten annotation) I wouldn't use upper-case for classes!

```
 97:        def __call__(self, parser, namespace, values, option_string=None):
 98:            if values <= 0:
 99:                parser.error("The number of cars must be a positive integer")
100:            setattr(namespace, self.dest, values)
101:
102:
103: # main program entry point
104: if __name__ == "__main__":
105:     logging.basicConfig(                                          # Configure the logging
106:         stream=sys.stdout,                                        # Output to console
107:         format='%(relativeCreated)6d %(threadName)s %(message)s',  # Format of the log
108:         level=logging.INFO                                        # Level of the log
109:     )
110:
111:     # Create the parser
112:     parser = argparse.ArgumentParser(description=__doc__,
113:                                      epilog="""Copyright 2021, School of Engineering and Architecture of Fribourg,
114:                                      Author: {} <{}>""".format(__author__, __email__))
115:     # Add the arguments
116:     parser.add_argument("-N", metavar=">= 0", type=int,
117:                         default=CAR_NORTH, help="Number of cars going north", action=CAR_ACTION)
118:     parser.add_argument("-S", metavar=">= 0", type=int,
119:                         default=CAR_SOUTH, help="Number of cars going south", action=CAR_ACTION)
120:     parser.add_argument("-n", metavar=">= 1", type=int,
121:                         default=CYCLE_NORTH, help="Number of time a car going north", action=CYCLE_ACTION)
122:     parser.add_argument("-s", metavar=">= 1", type=int,
123:                         default=CYCLE_SOUTH, help="Number of time a car going south", action=CYCLE_ACTION)
124:     parser.add_argument("-L", metavar=">= 1", type=int, default=LIMIT,
125:                         help="Max number of cars going in the same direction", action=LIMIT_ACTION)
126:
127:     # Parse the arguments
128:     args = parser.parse_args()
129:     main(args.N, args.S, args.n, args.s, args.L)
```

Git Logs

---

commit 1e755ebc74d7d03a992d415dcfa85ca6f0f00e0e (HEAD -> refs/heads/main, refs/remotes/origin/main, refs/remotes/origin/HEAD)
Author: Simon Barras <simon.barras02@gmail.com>
Date: Sun, 19 Dec 2021 19:10:11 +0100

    add documentation

---

commit 51f848af8b95613f43cebb3e370b390e67618f44
Author: Simon Barras <simon.barras02@gmail.com>
Date: Sat, 18 Dec 2021 22:20:45 +0100

    beautify code

---

commit b8da092302658ba87537b232c860c8fc9d47a01f
Author: Simon Barras <simon.barras02@gmail.com>
Date: Sat, 18 Dec 2021 22:02:07 +0100

    Rename test

---

commit ccf608f3bbe5c561e994f5e88519afcbe9ac593c
Author: Simon Barras <simon.barras02@gmail.com>
Date: Sat, 18 Dec 2021 21:43:17 +0100

    add tests

---

commit e44c433d9a95977d6ca18564d7050e7289a7d8e3
Author: Simon Barras <simon.barras02@gmail.com>
Date: Sat, 18 Dec 2021 20:41:25 +0100

    add functionnal monitor

---

commit 8149161411ae49b9b4995238f28016ede46e0944
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Date: Thu, 16 Dec 2021 20:11:14 +0100

    add monitor

Run params: -L1

```
Lab04 - The one-lane tunnel simulation
29 cars going north, 31 cars going south, 23 cycles north, 19 cycles south, limit 1
The tunnel monitor
    10 MainThread North: 0 is jumping in the car
    10 MainThread North: 1 is jumping in the car
    10 MainThread North: 2 is jumping in the car
    10 MainThread North: 3 is jumping in the car
    10 MainThread North: 4 is jumping in the car
    10 MainThread North: 5 is jumping in the car
    11 MainThread North: 6 is jumping in the car
    11 MainThread North: 7 is jumping in the car
    11 MainThread North: 8 is jumping in the car
    11 MainThread North: 9 is jumping in the car
    11 MainThread North: 10 is jumping in the car
    11 MainThread North: 11 is jumping in the car
    11 MainThread North: 12 is jumping in the car
    11 MainThread North: 13 is jumping in the car
    11 MainThread North: 14 is jumping in the car
    12 MainThread North: 15 is jumping in the car
    12 MainThread North: 16 is jumping in the car
    12 MainThread North: 17 is jumping in the car
    12 MainThread North: 18 is jumping in the car
    12 MainThread North: 19 is jumping in the car
    12 MainThread North: 20 is jumping in the car
    12 MainThread North: 21 is jumping in the car
    12 MainThread North: 22 is jumping in the car
    12 MainThread North: 23 is jumping in the car
    12 MainThread North: 24 is jumping in the car
    12 MainThread North: 25 is jumping in the car
    12 MainThread North: 26 is jumping in the car
    12 MainThread North: 27 is jumping in the car
    13 MainThread North: 28 is jumping in the car
    13 MainThread South: 0 is jumping in the car
    13 MainThread South: 1 is jumping in the car
    13 MainThread South: 2 is jumping in the car
    13 MainThread South: 3 is jumping in the car
    13 MainThread South: 4 is jumping in the car
    13 MainThread South: 5 is jumping in the car
    13 MainThread South: 6 is jumping in the car
    13 MainThread South: 7 is jumping in the car
    13 MainThread South: 8 is jumping in the car
    13 MainThread South: 9 is jumping in the car
    13 MainThread South: 10 is jumping in the car
    13 MainThread South: 11 is jumping in the car
    14 MainThread South: 12 is jumping in the car
    14 MainThread South: 13 is jumping in the car
    14 MainThread South: 14 is jumping in the car
    14 MainThread South: 15 is jumping in the car
    14 MainThread South: 16 is jumping in the car
    14 MainThread South: 17 is jumping in the car
    14 MainThread South: 18 is jumping in the car
    14 MainThread South: 19 is jumping in the car
    14 MainThread South: 20 is jumping in the car
    14 MainThread South: 21 is jumping in the car
    14 MainThread South: 22 is jumping in the car
    14 MainThread South: 23 is jumping in the car
    14 MainThread South: 24 is jumping in the car
```

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14 MainThread South: 25 is jumping in the car
15 MainThread South: 26 is jumping in the car
15 MainThread South: 27 is jumping in the car
15 MainThread South: 28 is jumping in the car
15 MainThread South: 29 is jumping in the car
15 MainThread South: 30 is jumping in the car
15 Thread-33 (drive) South: 3 is going to the tunnel entrance
17 Thread-60 (drive) South: 30 is going to the tunnel entrance
18 Thread-34 (drive) South: 4 is going to the tunnel entrance
18 Thread-15 (drive) North: 14 is going to the tunnel entrance
19 Thread-59 (drive) South: 29 is going to the tunnel entrance
19 Thread-11 (drive) North: 10 is going to the tunnel entrance
22 Thread-5 (drive) North: 4 is going to the tunnel entrance
22 Thread-26 (drive) North: 25 is going to the tunnel entrance
22 Thread-27 (drive) North: 26 is going to the tunnel entrance
22 Thread-43 (drive) South: 13 is going to the tunnel entrance
22 Thread-2 (drive) North: 1 is going to the tunnel entrance
22 Thread-10 (drive) North: 9 is going to the tunnel entrance
24 Thread-31 (drive) South: 1 is going to the tunnel entrance
24 Thread-9 (drive) North: 8 is going to the tunnel entrance
24 Thread-46 (drive) South: 16 is going to the tunnel entrance
26 Thread-27 (drive) North: 26 is waiting for the entrance permission
26 Thread-27 (drive) North: 26 is driving through the tunnel
26 Thread-10 (drive) North: 9 is waiting for the entrance permission
27 Thread-48 (drive) South: 18 is going to the tunnel entrance
27 Thread-10 (drive) North: 9 is driving through the tunnel
27 Thread-6 (drive) North: 5 is going to the tunnel entrance
27 Thread-3 (drive) North: 2 is going to the tunnel entrance
27 Thread-21 (drive) North: 20 is going to the tunnel entrance
27 Thread-8 (drive) North: 7 is going to the tunnel entrance
28 Thread-51 (drive) South: 21 is going to the tunnel entrance
32 Thread-19 (drive) North: 18 is going to the tunnel entrance
32 Thread-37 (drive) South: 7 is going to the tunnel entrance
32 Thread-32 (drive) South: 2 is going to the tunnel entrance
33 Thread-44 (drive) South: 14 is going to the tunnel entrance
36 Thread-34 (drive) South: 4 is waiting for the entrance permission
36 Thread-57 (drive) South: 27 is going to the tunnel entrance
37 Thread-58 (drive) South: 28 is going to the tunnel entrance
37 Thread-49 (drive) South: 19 is going to the tunnel entrance
37 Thread-31 (drive) South: 1 is waiting for the entrance permission
37 Thread-35 (drive) South: 5 is going to the tunnel entrance
37 Thread-42 (drive) South: 12 is going to the tunnel entrance
37 Thread-54 (drive) South: 24 is going to the tunnel entrance
37 Thread-7 (drive) North: 6 is going to the tunnel entrance
37 Thread-4 (drive) North: 3 is going to the tunnel entrance
41 Thread-32 (drive) South: 2 is waiting for the entrance permission
42 Thread-55 (drive) South: 25 is going to the tunnel entrance
42 Thread-23 (drive) North: 22 is going to the tunnel entrance
42 Thread-52 (drive) South: 22 is going to the tunnel entrance
42 Thread-40 (drive) South: 10 is going to the tunnel entrance
42 Thread-49 (drive) South: 19 is waiting for the entrance permission
42 Thread-21 (drive) North: 20 is waiting for the entrance permission
42 Thread-20 (drive) North: 19 is going to the tunnel entrance
43 Thread-38 (drive) South: 8 is going to the tunnel entrance
43 Thread-13 (drive) North: 12 is going to the tunnel entrance
43 Thread-60 (drive) South: 30 is waiting for the entrance permission
43 Thread-46 (drive) South: 16 is waiting for the entrance permission
43 Thread-27 (drive) North: 26 is leaving the tunnel
43 Thread-5 (drive) North: 4 is waiting for the entrance permission
```

1 north
2 north
=> in tunnel

1 south waiting

2 soll waiting

1 north in tunnel

2

```
43 Thread-17 (drive) North: 16 is going to the tunnel entrance
43 Thread-12 (drive) North: 11 is going to the tunnel entrance
44 Thread-21 (drive) North: 20 is driving through the tunnel
44 Thread-27 (drive) North: 26 is going back to the origin
45 Thread-24 (drive) North: 23 is going to the tunnel entrance
45 Thread-53 (drive) South: 23 is going to the tunnel entrance
48 Thread-35 (drive) South: 5 is waiting for the entrance permission
49 Thread-1 (drive) North: 0 is going to the tunnel entrance
49 Thread-4 (drive) North: 3 is waiting for the entrance permission
49 Thread-45 (drive) South: 15 is going to the tunnel entrance
49 Thread-58 (drive) South: 28 is waiting for the entrance permission
50 Thread-16 (drive) North: 15 is going to the tunnel entrance
50 Thread-50 (drive) South: 20 is going to the tunnel entrance
50 Thread-22 (drive) North: 21 is going to the tunnel entrance
50 Thread-41 (drive) South: 11 is going to the tunnel entrance
51 Thread-39 (drive) South: 9 is going to the tunnel entrance
51 Thread-33 (drive) South: 3 is waiting for the entrance permission
51 Thread-26 (drive) North: 25 is waiting for the entrance permission
51 Thread-47 (drive) South: 17 is going to the tunnel entrance
55 Thread-53 (drive) South: 23 is waiting for the entrance permission
56 Thread-14 (drive) North: 13 is going to the tunnel entrance
56 Thread-6 (drive) North: 5 is waiting for the entrance permission
56 Thread-23 (drive) North: 22 is waiting for the entrance permission
56 Thread-40 (drive) South: 10 is waiting for the entrance permission
56 Thread-18 (drive) North: 17 is going to the tunnel entrance
57 Thread-29 (drive) North: 28 is going to the tunnel entrance
57 Thread-30 (drive) South: 0 is going to the tunnel entrance
57 Thread-15 (drive) North: 14 is waiting for the entrance permission
57 Thread-59 (drive) South: 29 is waiting for the entrance permission
57 Thread-28 (drive) North: 27 is going to the tunnel entrance
57 Thread-56 (drive) South: 26 is going to the tunnel entrance
57 Thread-13 (drive) North: 12 is waiting for the entrance permission
58 Thread-25 (drive) North: 24 is going to the tunnel entrance
58 Thread-51 (drive) South: 21 is waiting for the entrance permission
61 Thread-14 (drive) North: 13 is waiting for the entrance permission
61 Thread-8 (drive) North: 7 is waiting for the entrance permission
61 Thread-36 (drive) South: 6 is going to the tunnel entrance
62 Thread-19 (drive) North: 18 is waiting for the entrance permission
62 Thread-2 (drive) North: 1 is waiting for the entrance permission
62 Thread-16 (drive) North: 15 is waiting for the entrance permission
62 Thread-11 (drive) North: 10 is waiting for the entrance permission
63 Thread-27 (drive) North: 26 is going to the tunnel entrance
63 Thread-27 (drive) North: 26 is waiting for the entrance permission
63 Thread-3 (drive) North: 2 is waiting for the entrance permission
63 Thread-9 (drive) North: 8 is waiting for the entrance permission
63 Thread-48 (drive) South: 18 is waiting for the entrance permission
66 Thread-50 (drive) South: 20 is waiting for the entrance permission
67 Thread-10 (drive) North: 9 is leaving the tunnel
67 Thread-10 (drive) North: 9 is going back to the origin
67 Thread-52 (drive) South: 22 is waiting for the entrance permission
67 Thread-18 (drive) North: 17 is waiting for the entrance permission
67 Thread-44 (drive) South: 14 is waiting for the entrance permission
68 Thread-57 (drive) South: 27 is waiting for the entrance permission
68 Thread-37 (drive) South: 7 is waiting for the entrance permission
69 Thread-38 (drive) South: 8 is waiting for the entrance permission
70 Thread-12 (drive) North: 11 is waiting for the entrance permission
70 Thread-55 (drive) South: 25 is waiting for the entrance permission
70 Thread-7 (drive) North: 6 is waiting for the entrance permission
70 Thread-20 (drive) North: 19 is waiting for the entrance permission
```

[handwritten annotation: → this is wrong! with L1 at least one south vehicle should pass now!]

3

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  70 Thread-47 (drive) South: 17 is waiting for the entrance permission
  70 Thread-43 (drive) South: 13 is waiting for the entrance permission
  77 Thread-42 (drive) South: 12 is waiting for the entrance permission
  78 Thread-28 (drive) North: 27 is waiting for the entrance permission
  78 Thread-22 (drive) North: 21 is waiting for the entrance permission
  78 Thread-54 (drive) South: 24 is waiting for the entrance permission
  84 Thread-24 (drive) North: 23 is waiting for the entrance permission
  84 Thread-25 (drive) North: 24 is waiting for the entrance permission
  85 Thread-56 (drive) South: 26 is waiting for the entrance permission
  86 Thread-17 (drive) North: 16 is waiting for the entrance permission
  86 Thread-21 (drive) North: 20 is leaving the tunnel
  87 Thread-39 (drive) South: 9 is waiting for the entrance permission
  87 Thread-21 (drive) North: 20 is going back to the origin
  87 Thread-39 (drive) South: 9 is driving through the tunnel
  93 Thread-41 (drive) South: 11 is waiting for the entrance permission
  93 Thread-1 (drive) North: 0 is waiting for the entrance permission
  94 Thread-39 (drive) South: 9 is leaving the tunnel
  94 Thread-39 (drive) South: 9 is going back to the origin
  94 Thread-5 (drive) North: 4 is driving through the tunnel
  94 Thread-29 (drive) North: 28 is waiting for the entrance permission
  99 Thread-10 (drive) North: 9 is going to the tunnel entrance
  99 Thread-45 (drive) South: 15 is waiting for the entrance permission
 103 Thread-30 (drive) South: 0 is waiting for the entrance permission
 103 Thread-36 (drive) South: 6 is waiting for the entrance permission
 120 Thread-21 (drive) North: 20 is going to the tunnel entrance

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#######################..... 6202 lines skipped ......#########################
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 31805 Thread-25 (drive) North: 24 is going back to the origin
 31811 Thread-22 (drive) North: 21 is leaving the tunnel
 31812 Thread-22 (drive) North: 21 is going back to the origin
 31815 Thread-3 (drive) North: 2 is leaving the tunnel
 31815 Thread-4 (drive) North: 3 is leaving the tunnel
 31815 Thread-3 (drive) North: 2 is going back to the origin
 31815 Thread-4 (drive) North: 3 is going back to the origin
 31818 Thread-20 (drive) North: 19 is leaving the tunnel
 31818 Thread-20 (drive) North: 19 is going back to the origin
 31819 Thread-23 (drive) North: 22 is leaving the tunnel
 31819 Thread-23 (drive) North: 22 is going back to the origin
 31819 Thread-1 (drive) North: 0 is leaving the tunnel
 31819 Thread-1 (drive) North: 0 is going back to the origin
 31819 Thread-2 (drive) North: 1 is leaving the tunnel
 31820 Thread-2 (drive) North: 1 is going back to the origin
 31826 Thread-17 (drive) North: 16 is going to the tunnel entrance
 31826 Thread-8 (drive) North: 7 is leaving the tunnel
 31827 Thread-8 (drive) North: 7 is going back to the origin
 31828 Thread-18 (drive) North: 17 is leaving the tunnel
 31829 Thread-29 (drive) North: 28 is leaving the tunnel
 31829 Thread-12 (drive) North: 11 is leaving the tunnel
 31829 Thread-2 (drive) North: 1 is going to the tunnel entrance
 31829 Thread-11 (drive) North: 10 is leaving the tunnel
 31829 Thread-18 (drive) North: 17 is going back to the origin
 31829 Thread-29 (drive) North: 28 is going back to the origin
 31829 Thread-12 (drive) North: 11 is going back to the origin
 31830 Thread-11 (drive) North: 10 is going back to the origin
 31830 Thread-26 (drive) North: 25 is leaving the tunnel
 31830 Thread-28 (drive) North: 27 is leaving the tunnel
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31830 Thread-9 (drive) North: 8 is leaving the tunnel
31830 Thread-19 (drive) North: 18 is leaving the tunnel
31830 Thread-16 (drive) North: 15 is leaving the tunnel
31831 Thread-26 (drive) North: 25 is going back to the origin
31831 Thread-28 (drive) North: 27 is going back to the origin
31831 Thread-9 (drive) North: 8 is going back to the origin
31831 Thread-19 (drive) North: 18 is going back to the origin
31831 Thread-13 (drive) North: 12 is waiting for the entrance permission
31832 Thread-16 (drive) North: 15 is going back to the origin
31833 Thread-13 (drive) North: 12 is driving through the tunnel
31837 Thread-1 (drive) North: 0 is going to the tunnel entrance
31837 Thread-17 (drive) North: 16 is waiting for the entrance permission
31837 Thread-17 (drive) North: 16 is driving through the tunnel
31837 Thread-24 (drive) North: 23 is leaving the tunnel
31838 Thread-24 (drive) North: 23 is going back to the origin
31838 Thread-7 (drive) North: 6 is leaving the tunnel
31838 Thread-7 (drive) North: 6 is going back to the origin
31838 Thread-14 (drive) North: 13 is leaving the tunnel
31838 Thread-14 (drive) North: 13 is going back to the origin
31838 Thread-4 (drive) North: 3 is going to the tunnel entrance
31843 Thread-24 (drive) North: 23 is going to the tunnel entrance
31848 Thread-19 (drive) North: 18 is going to the tunnel entrance
31854 Thread-13 (drive) North: 12 is leaving the tunnel
31855 Thread-20 (drive) North: 19 is going to the tunnel entrance
31855 Thread-8 (drive) North: 7 is going to the tunnel entrance
31855 Thread-13 (drive) North: 12 is going back to the origin
31859 Thread-3 (drive) North: 2 is going to the tunnel entrance
31859 Thread-22 (drive) North: 21 is going to the tunnel entrance
31859 Thread-18 (drive) North: 17 is going to the tunnel entrance
31859 Thread-1 (drive) North: 0 is waiting for the entrance permission
31859 Thread-11 (drive) North: 10 is going to the tunnel entrance
31860 Thread-4 (drive) North: 3 is waiting for the entrance permission
31860 Thread-14 (drive) North: 13 is going to the tunnel entrance
31860 Thread-1 (drive) North: 0 is driving through the tunnel
31860 Thread-19 (drive) North: 18 is waiting for the entrance permission
31861 Thread-4 (drive) North: 3 is driving through the tunnel
31861 Thread-19 (drive) North: 18 is driving through the tunnel
31865 Thread-2 (drive) North: 1 is waiting for the entrance permission
31865 Thread-2 (drive) North: 1 is driving through the tunnel
31870 Thread-17 (drive) North: 16 is leaving the tunnel
31870 Thread-17 (drive) North: 16 is going back to the origin
31870 Thread-28 (drive) North: 27 is going to the tunnel entrance
31874 Thread-29 (drive) North: 28 is going to the tunnel entrance
31876 Thread-16 (drive) North: 15 is going to the tunnel entrance
31881 Thread-28 (drive) North: 27 is waiting for the entrance permission
31881 Thread-28 (drive) North: 27 is driving through the tunnel
31881 Thread-7 (drive) North: 6 is going to the tunnel entrance
31881 Thread-20 (drive) North: 19 is waiting for the entrance permission
31881 Thread-20 (drive) North: 19 is driving through the tunnel
31882 Thread-3 (drive) North: 2 is waiting for the entrance permission
31882 Thread-3 (drive) North: 2 is driving through the tunnel
31887 Thread-24 (drive) North: 23 is waiting for the entrance permission
31887 Thread-24 (drive) North: 23 is driving through the tunnel
31888 Thread-2 (drive) North: 1 is leaving the tunnel
31888 Thread-2 (drive) North: 1 is going back to the origin
31888 Thread-1 (drive) North: 0 is leaving the tunnel
31888 Thread-1 (drive) North: 0 is going back to the origin
31891 Thread-7 (drive) North: 6 is waiting for the entrance permission
31892 Thread-7 (drive) North: 6 is driving through the tunnel
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31892 Thread-16 (drive) North: 15 is waiting for the entrance permission
31892 Thread-16 (drive) North: 15 is driving through the tunnel
31892 Thread-14 (drive) North: 13 is waiting for the entrance permission
31892 Thread-14 (drive) North: 13 is driving through the tunnel
31893 Thread-19 (drive) North: 18 is leaving the tunnel
31893 Thread-19 (drive) North: 18 is going back to the origin
31893 Thread-28 (drive) North: 27 is leaving the tunnel
31893 Thread-28 (drive) North: 27 is going back to the origin
31893 Thread-4 (drive) North: 3 is leaving the tunnel
31893 Thread-4 (drive) North: 3 is going back to the origin
31896 Thread-24 (drive) North: 23 is leaving the tunnel
31896 Thread-24 (drive) North: 23 is going back to the origin
31897 Thread-18 (drive) North: 17 is waiting for the entrance permission
31897 Thread-18 (drive) North: 17 is driving through the tunnel
31897 Thread-11 (drive) North: 10 is waiting for the entrance permission
31897 Thread-11 (drive) North: 10 is driving through the tunnel
31897 Thread-3 (drive) North: 2 is leaving the tunnel
31898 Thread-3 (drive) North: 2 is going back to the origin
31898 Thread-8 (drive) North: 7 is waiting for the entrance permission
31898 Thread-8 (drive) North: 7 is driving through the tunnel
31904 Thread-8 (drive) North: 7 is leaving the tunnel
31905 Thread-22 (drive) North: 21 is waiting for the entrance permission
31905 Thread-29 (drive) North: 28 is waiting for the entrance permission
31905 Thread-8 (drive) North: 7 is going back to the origin
31905 MainThread North: 0 is getting out of the car
31906 Thread-22 (drive) North: 21 is driving through the tunnel
31906 Thread-29 (drive) North: 28 is driving through the tunnel
31906 Thread-16 (drive) North: 15 is leaving the tunnel
31906 Thread-16 (drive) North: 15 is going back to the origin
31914 Thread-7 (drive) North: 6 is leaving the tunnel
31914 Thread-7 (drive) North: 6 is going back to the origin
31914 Thread-14 (drive) North: 13 is leaving the tunnel
31914 Thread-14 (drive) North: 13 is going back to the origin
31915 Thread-29 (drive) North: 28 is leaving the tunnel
31915 Thread-29 (drive) North: 28 is going back to the origin
31922 Thread-18 (drive) North: 17 is leaving the tunnel
31922 Thread-20 (drive) North: 19 is leaving the tunnel
31922 Thread-18 (drive) North: 17 is going back to the origin
31922 Thread-20 (drive) North: 19 is going back to the origin
31925 MainThread North: 1 is getting out of the car
31931 Thread-22 (drive) North: 21 is leaving the tunnel
31932 Thread-11 (drive) North: 10 is leaving the tunnel
31932 Thread-29 (drive) North: 28 is going to the tunnel entrance
31932 Thread-22 (drive) North: 21 is going back to the origin
31932 Thread-11 (drive) North: 10 is going back to the origin
31941 MainThread North: 2 is getting out of the car
31941 MainThread North: 3 is getting out of the car
31942 MainThread North: 4 is getting out of the car
31942 MainThread North: 5 is getting out of the car
31947 Thread-7 (drive) North: 6 is going to the tunnel entrance
31969 Thread-29 (drive) North: 28 is waiting for the entrance permission
31969 Thread-29 (drive) North: 28 is driving through the tunnel
31988 Thread-7 (drive) North: 6 is waiting for the entrance permission
31988 Thread-7 (drive) North: 6 is driving through the tunnel
32002 Thread-29 (drive) North: 28 is leaving the tunnel
32002 Thread-29 (drive) North: 28 is going back to the origin
32024 Thread-7 (drive) North: 6 is leaving the tunnel
32024 Thread-7 (drive) North: 6 is going back to the origin
32066 MainThread North: 6 is getting out of the car
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32066 MainThread North: 7 is getting out of the car
32066 MainThread North: 8 is getting out of the car
32066 MainThread North: 9 is getting out of the car
32066 MainThread North: 10 is getting out of the car
32067 MainThread North: 11 is getting out of the car
32067 MainThread North: 12 is getting out of the car
32067 MainThread North: 13 is getting out of the car
32067 MainThread North: 14 is getting out of the car
32067 MainThread North: 15 is getting out of the car
32067 MainThread North: 16 is getting out of the car
32067 MainThread North: 17 is getting out of the car
32067 MainThread North: 18 is getting out of the car
32067 MainThread North: 19 is getting out of the car
32067 MainThread North: 20 is getting out of the car
32067 MainThread North: 21 is getting out of the car
32067 MainThread North: 22 is getting out of the car
32067 MainThread North: 23 is getting out of the car
32067 MainThread North: 24 is getting out of the car
32067 MainThread North: 25 is getting out of the car
32067 MainThread North: 26 is getting out of the car
32068 MainThread North: 27 is getting out of the car
32068 MainThread North: 28 is getting out of the car
32068 MainThread South: 0 is getting out of the car
32068 MainThread South: 1 is getting out of the car
32068 MainThread South: 2 is getting out of the car
32068 MainThread South: 3 is getting out of the car
32068 MainThread South: 4 is getting out of the car
32068 MainThread South: 5 is getting out of the car
32068 MainThread South: 6 is getting out of the car
32068 MainThread South: 7 is getting out of the car
32068 MainThread South: 8 is getting out of the car
32068 MainThread South: 9 is getting out of the car
32068 MainThread South: 10 is getting out of the car
32068 MainThread South: 11 is getting out of the car
32068 MainThread South: 12 is getting out of the car
32068 MainThread South: 13 is getting out of the car
32068 MainThread South: 14 is getting out of the car
32068 MainThread South: 15 is getting out of the car
32068 MainThread South: 16 is getting out of the car
32069 MainThread South: 17 is getting out of the car
32069 MainThread South: 18 is getting out of the car
32069 MainThread South: 19 is getting out of the car
32069 MainThread South: 20 is getting out of the car
32069 MainThread South: 21 is getting out of the car
32069 MainThread South: 22 is getting out of the car
32069 MainThread South: 23 is getting out of the car
32069 MainThread South: 24 is getting out of the car
32069 MainThread South: 25 is getting out of the car
32069 MainThread South: 26 is getting out of the car
32069 MainThread South: 27 is getting out of the car
32069 MainThread South: 28 is getting out of the car
32069 MainThread South: 29 is getting out of the car
32069 MainThread South: 30 is getting out of the car
```

Run params: -L3–s1–S1–n1–N1

```
Lab04 - The one-lane tunnel simulation
1 cars going north, 1 cars going south, 1 cycles north, 1 cycles south, limit 3
The tunnel monitor
    10 MainThread North: 0 is jumping in the car
    10 MainThread South: 0 is jumping in the car
    40 Thread-1 (drive) North: 0 is going to the tunnel entrance
    57 Thread-2 (drive) South: 0 is going to the tunnel entrance
    73 Thread-1 (drive) North: 0 is waiting for the entrance permission
    74 Thread-1 (drive) North: 0 is driving through the tunnel
    93 Thread-1 (drive) North: 0 is leaving the tunnel
    93 Thread-1 (drive) North: 0 is going back to the origin
   106 Thread-2 (drive) South: 0 is waiting for the entrance permission
   106 Thread-2 (drive) South: 0 is driving through the tunnel
   124 MainThread North: 0 is getting out of the car
   152 Thread-2 (drive) South: 0 is leaving the tunnel
   152 Thread-2 (drive) South: 0 is going back to the origin
   195 MainThread South: 0 is getting out of the car
```

Run params: -N3–S5–n0

```
usage: tunnel.py [-h] [-N >= 0] [-S >= 0] [-n >= 1] [-s >= 1] [-L >= 1]
tunnel.py: error: The number of cycles must be a positive integer
```

usage: tunnel.py [-h] [-N >= 0] [-S >= 0] [-n >= 1] [-s >= 1] [-L >= 1]
tunnel.py: error: The number of cycles must be a positive integer

Run params: -s1–S0–n1–N0

```
Lab04 - The one-lane tunnel simulation
0 cars going north, 0 cars going south, 1 cycles north, 1 cycles south, limit 5
The tunnel monitor
```

Run params: -s2–S1–N0–L7

```
Lab04 - The one-lane tunnel simulation
0 cars going north, 1 cars going south, 23 cycles north, 2 cycles south, limit 7
The tunnel monitor
     9 MainThread South: 0 is jumping in the car
    58 Thread-1 (drive) South: 0 is going to the tunnel entrance
   102 Thread-1 (drive) South: 0 is waiting for the entrance permission
   102 Thread-1 (drive) South: 0 is driving through the tunnel
   141 Thread-1 (drive) South: 0 is leaving the tunnel
   141 Thread-1 (drive) South: 0 is going back to the origin
   154 Thread-1 (drive) South: 0 is going to the tunnel entrance
   188 Thread-1 (drive) South: 0 is waiting for the entrance permission
   188 Thread-1 (drive) South: 0 is driving through the tunnel
   212 Thread-1 (drive) South: 0 is leaving the tunnel
   212 Thread-1 (drive) South: 0 is going back to the origin
   253 MainThread South: 0 is getting out of the car
```

Run params: -s7–S13–N1–n2–L5

```
Lab04 - The one-lane tunnel simulation
1 cars going north, 13 cars going south, 2 cycles north, 7 cycles south, limit 5
The tunnel monitor
    12 MainThread North: 0 is jumping in the car
    12 MainThread South: 0 is jumping in the car
    12 MainThread South: 1 is jumping in the car
    12 MainThread South: 2 is jumping in the car
    13 MainThread South: 3 is jumping in the car
    13 MainThread South: 4 is jumping in the car
    13 MainThread South: 5 is jumping in the car
    13 MainThread South: 6 is jumping in the car
    13 MainThread South: 7 is jumping in the car
    13 MainThread South: 8 is jumping in the car
    13 MainThread South: 9 is jumping in the car
    14 MainThread South: 10 is jumping in the car
    14 MainThread South: 11 is jumping in the car
    14 MainThread South: 12 is jumping in the car
    20 Thread-4 (drive) South: 2 is going to the tunnel entrance
    20 Thread-13 (drive) South: 11 is going to the tunnel entrance
    28 Thread-3 (drive) South: 1 is going to the tunnel entrance
    28 Thread-2 (drive) South: 0 is going to the tunnel entrance
    28 Thread-1 (drive) North: 0 is going to the tunnel entrance
    29 Thread-8 (drive) South: 6 is going to the tunnel entrance
    30 Thread-13 (drive) South: 11 is waiting for the entrance permission
    30 Thread-13 (drive) South: 11 is driving through the tunnel
    31 Thread-11 (drive) South: 9 is going to the tunnel entrance
    33 Thread-10 (drive) South: 8 is going to the tunnel entrance
    35 Thread-4 (drive) South: 2 is waiting for the entrance permission
    35 Thread-4 (drive) South: 2 is driving through the tunnel
    40 Thread-12 (drive) South: 10 is going to the tunnel entrance
    41 Thread-1 (drive) North: 0 is waiting for the entrance permission
    43 Thread-5 (drive) South: 3 is going to the tunnel entrance
    43 Thread-4 (drive) South: 2 is leaving the tunnel
    43 Thread-4 (drive) South: 2 is going back to the origin
    47 Thread-11 (drive) South: 9 is waiting for the entrance permission
    47 Thread-11 (drive) South: 9 is driving through the tunnel
    53 Thread-3 (drive) South: 1 is waiting for the entrance permission
    53 Thread-3 (drive) South: 1 is driving through the tunnel
    53 Thread-14 (drive) South: 12 is going to the tunnel entrance
    53 Thread-2 (drive) South: 0 is waiting for the entrance permission
    53 Thread-2 (drive) South: 0 is driving through the tunnel
    55 Thread-12 (drive) South: 10 is waiting for the entrance permission
    55 Thread-6 (drive) South: 4 is going to the tunnel entrance
    55 Thread-8 (drive) South: 6 is waiting for the entrance permission
    55 Thread-8 (drive) South: 6 is driving through the tunnel
    55 Thread-12 (drive) South: 10 is driving through the tunnel
    57 Thread-9 (drive) South: 7 is going to the tunnel entrance
    59 Thread-13 (drive) South: 11 is leaving the tunnel
    59 Thread-13 (drive) South: 11 is going back to the origin
    63 Thread-7 (drive) South: 5 is going to the tunnel entrance
    64 Thread-3 (drive) South: 1 is leaving the tunnel
    64 Thread-3 (drive) South: 1 is going back to the origin
    66 Thread-6 (drive) South: 4 is waiting for the entrance permission
    66 Thread-10 (drive) South: 8 is waiting for the entrance permission
    73 Thread-4 (drive) South: 2 is going to the tunnel entrance
    80 Thread-3 (drive) South: 1 is going to the tunnel entrance
    81 Thread-9 (drive) South: 7 is waiting for the entrance permission
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 81 Thread-8 (drive) South: 6 is leaving the tunnel
 81 Thread-7 (drive) South: 5 is waiting for the entrance permission
 81 Thread-14 (drive) South: 12 is waiting for the entrance permission
 81 Thread-2 (drive) South: 0 is leaving the tunnel
 81 Thread-8 (drive) South: 6 is going back to the origin
 81 Thread-2 (drive) South: 0 is going back to the origin
 96 Thread-11 (drive) South: 9 is leaving the tunnel
 96 Thread-3 (drive) South: 1 is waiting for the entrance permission
 96 Thread-12 (drive) South: 10 is leaving the tunnel
 97 Thread-13 (drive) South: 11 is going to the tunnel entrance
 97 Thread-5 (drive) South: 3 is waiting for the entrance permission
 97 Thread-11 (drive) South: 9 is going back to the origin
 97 Thread-12 (drive) South: 10 is going back to the origin
 97 Thread-1 (drive) North: 0 is driving through the tunnel
 98 Thread-4 (drive) South: 2 is waiting for the entrance permission
104 Thread-13 (drive) South: 11 is waiting for the entrance permission
115 Thread-11 (drive) South: 9 is going to the tunnel entrance
121 Thread-12 (drive) South: 10 is going to the tunnel entrance
125 Thread-1 (drive) North: 0 is leaving the tunnel
125 Thread-8 (drive) South: 6 is going to the tunnel entrance
125 Thread-1 (drive) North: 0 is going back to the origin
125 Thread-6 (drive) South: 4 is driving through the tunnel
125 Thread-10 (drive) South: 8 is driving through the tunnel
125 Thread-7 (drive) South: 5 is driving through the tunnel
125 Thread-9 (drive) South: 7 is driving through the tunnel
125 Thread-14 (drive) South: 12 is driving through the tunnel
125 Thread-3 (drive) South: 1 is driving through the tunnel
126 Thread-5 (drive) South: 3 is driving through the tunnel
126 Thread-4 (drive) South: 2 is driving through the tunnel
126 Thread-13 (drive) South: 11 is driving through the tunnel
135 Thread-1 (drive) North: 0 is going to the tunnel entrance
138 Thread-4 (drive) South: 2 is leaving the tunnel
138 Thread-4 (drive) South: 2 is going back to the origin
138 Thread-12 (drive) South: 10 is waiting for the entrance permission
139 Thread-12 (drive) South: 10 is driving through the tunnel
139 Thread-2 (drive) South: 0 is going to the tunnel entrance
139 Thread-6 (drive) South: 4 is leaving the tunnel
139 Thread-6 (drive) South: 4 is going back to the origin
148 Thread-2 (drive) South: 0 is waiting for the entrance permission
148 Thread-2 (drive) South: 0 is driving through the tunnel
150 Thread-4 (drive) South: 2 is going to the tunnel entrance
150 Thread-7 (drive) South: 5 is leaving the tunnel
150 Thread-11 (drive) South: 9 is waiting for the entrance permission
150 Thread-7 (drive) South: 5 is going back to the origin
150 Thread-11 (drive) South: 9 is driving through the tunnel
153 Thread-4 (drive) South: 2 is waiting for the entrance permission
153 Thread-4 (drive) South: 2 is driving through the tunnel
159 Thread-8 (drive) South: 6 is waiting for the entrance permission
159 Thread-14 (drive) South: 12 is leaving the tunnel
159 Thread-13 (drive) South: 11 is leaving the tunnel
159 Thread-3 (drive) South: 1 is leaving the tunnel
159 Thread-8 (drive) South: 6 is driving through the tunnel
159 Thread-14 (drive) South: 12 is going back to the origin
159 Thread-13 (drive) South: 11 is going back to the origin
159 Thread-3 (drive) South: 1 is going back to the origin
160 Thread-7 (drive) South: 5 is going to the tunnel entrance
163 Thread-4 (drive) South: 2 is leaving the tunnel
163 Thread-4 (drive) South: 2 is going back to the origin
166 Thread-10 (drive) South: 8 is leaving the tunnel
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166 Thread-10 (drive) South: 8 is going back to the origin
166 Thread-9 (drive) South: 7 is leaving the tunnel
167 Thread-6 (drive) South: 4 is going to the tunnel entrance
167 Thread-9 (drive) South: 7 is going back to the origin
170 Thread-8 (drive) South: 6 is leaving the tunnel
170 Thread-8 (drive) South: 6 is going back to the origin
170 Thread-5 (drive) South: 3 is leaving the tunnel
171 Thread-14 (drive) South: 12 is going to the tunnel entrance
171 Thread-5 (drive) South: 3 is going back to the origin
176 Thread-4 (drive) South: 2 is going to the tunnel entrance
176 Thread-12 (drive) South: 10 is leaving the tunnel
176 Thread-12 (drive) South: 10 is going back to the origin
176 Thread-11 (drive) South: 9 is leaving the tunnel
177 Thread-11 (drive) South: 9 is going back to the origin
179 Thread-6 (drive) South: 4 is waiting for the entrance permission
179 Thread-6 (drive) South: 4 is driving through the tunnel
181 Thread-10 (drive) South: 8 is going to the tunnel entrance
181 Thread-7 (drive) South: 5 is waiting for the entrance permission
181 Thread-7 (drive) South: 5 is driving through the tunnel
182 Thread-11 (drive) South: 9 is going to the tunnel entrance
186 Thread-10 (drive) South: 8 is waiting for the entrance permission
186 Thread-10 (drive) South: 8 is driving through the tunnel
188 Thread-1 (drive) North: 0 is waiting for the entrance permission
188 Thread-13 (drive) South: 11 is going to the tunnel entrance
188 Thread-2 (drive) South: 0 is leaving the tunnel
188 Thread-14 (drive) South: 12 is waiting for the entrance permission
188 Thread-2 (drive) South: 0 is going back to the origin
188 Thread-14 (drive) South: 12 is driving through the tunnel
189 Thread-11 (drive) South: 9 is waiting for the entrance permission
189 Thread-11 (drive) South: 9 is driving through the tunnel
192 Thread-13 (drive) South: 11 is waiting for the entrance permission
192 Thread-13 (drive) South: 11 is driving through the tunnel
195 Thread-6 (drive) South: 4 is leaving the tunnel
195 Thread-6 (drive) South: 4 is going back to the origin
200 Thread-14 (drive) South: 12 is leaving the tunnel
200 Thread-4 (drive) South: 2 is waiting for the entrance permission
201 Thread-14 (drive) South: 12 is going back to the origin
201 Thread-4 (drive) South: 2 is driving through the tunnel
201 Thread-3 (drive) South: 1 is going to the tunnel entrance
204 Thread-8 (drive) South: 6 is going to the tunnel entrance
205 Thread-2 (drive) South: 0 is going to the tunnel entrance
207 Thread-9 (drive) South: 7 is going to the tunnel entrance
212 Thread-4 (drive) South: 2 is leaving the tunnel
212 Thread-5 (drive) South: 3 is going to the tunnel entrance
212 Thread-4 (drive) South: 2 is going back to the origin
213 Thread-8 (drive) South: 6 is waiting for the entrance permission
213 Thread-8 (drive) South: 6 is driving through the tunnel
217 Thread-13 (drive) South: 11 is leaving the tunnel
217 Thread-13 (drive) South: 11 is going back to the origin
217 Thread-12 (drive) South: 10 is going to the tunnel entrance
221 Thread-12 (drive) South: 10 is waiting for the entrance permission
224 Thread-14 (drive) South: 12 is going to the tunnel entrance
225 Thread-13 (drive) South: 11 is going to the tunnel entrance
225 Thread-10 (drive) South: 8 is leaving the tunnel
225 Thread-10 (drive) South: 8 is going back to the origin
226 Thread-6 (drive) South: 4 is going to the tunnel entrance
226 Thread-7 (drive) South: 5 is leaving the tunnel
226 Thread-7 (drive) South: 5 is going back to the origin
229 Thread-11 (drive) South: 9 is leaving the tunnel
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229 Thread-11 (drive) South: 9 is going back to the origin
230 Thread-13 (drive) South: 11 is waiting for the entrance permission
231 Thread-8 (drive) South: 6 is leaving the tunnel
231 Thread-8 (drive) South: 6 is going back to the origin
231 Thread-1 (drive) North: 0 is driving through the tunnel
232 Thread-11 (drive) South: 9 is going to the tunnel entrance
234 Thread-3 (drive) South: 1 is waiting for the entrance permission
237 Thread-9 (drive) South: 7 is waiting for the entrance permission
237 Thread-14 (drive) South: 12 is waiting for the entrance permission
241 Thread-5 (drive) South: 3 is waiting for the entrance permission
245 Thread-4 (drive) South: 2 is going to the tunnel entrance
248 Thread-8 (drive) South: 6 is going to the tunnel entrance
253 Thread-2 (drive) South: 0 is waiting for the entrance permission
256 Thread-7 (drive) South: 5 is going to the tunnel entrance
256 Thread-6 (drive) South: 4 is waiting for the entrance permission
258 Thread-10 (drive) South: 8 is going to the tunnel entrance
261 Thread-8 (drive) South: 6 is waiting for the entrance permission
266 Thread-4 (drive) South: 2 is waiting for the entrance permission
266 Thread-7 (drive) South: 5 is waiting for the entrance permission
267 Thread-10 (drive) South: 8 is waiting for the entrance permission
270 Thread-1 (drive) North: 0 is leaving the tunnel
270 Thread-1 (drive) North: 0 is going back to the origin
270 Thread-14 (drive) South: 12 is driving through the tunnel
270 Thread-3 (drive) South: 1 is driving through the tunnel
270 Thread-9 (drive) South: 7 is driving through the tunnel


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#########################..... 295 lines skipped ......###########################
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373 Thread-6 (drive) South: 4 is going back to the origin
376 Thread-8 (drive) South: 6 is going to the tunnel entrance
376 Thread-7 (drive) South: 5 is waiting for the entrance permission
376 Thread-13 (drive) South: 11 is waiting for the entrance permission
376 Thread-7 (drive) South: 5 is driving through the tunnel
376 Thread-13 (drive) South: 11 is driving through the tunnel
382 Thread-10 (drive) South: 8 is going to the tunnel entrance
382 Thread-3 (drive) South: 1 is going to the tunnel entrance
389 Thread-9 (drive) South: 7 is leaving the tunnel
389 Thread-9 (drive) South: 7 is going back to the origin
390 Thread-8 (drive) South: 6 is waiting for the entrance permission
390 Thread-8 (drive) South: 6 is driving through the tunnel
390 Thread-2 (drive) South: 0 is leaving the tunnel
390 Thread-2 (drive) South: 0 is going back to the origin
398 Thread-14 (drive) South: 12 is waiting for the entrance permission
398 Thread-14 (drive) South: 12 is driving through the tunnel
398 Thread-4 (drive) South: 2 is waiting for the entrance permission
398 Thread-4 (drive) South: 2 is driving through the tunnel
401 Thread-4 (drive) South: 2 is leaving the tunnel
401 Thread-4 (drive) South: 2 is going back to the origin
404 Thread-6 (drive) South: 4 is going to the tunnel entrance
406 Thread-12 (drive) South: 10 is going to the tunnel entrance
406 Thread-11 (drive) South: 9 is waiting for the entrance permission
406 Thread-11 (drive) South: 9 is driving through the tunnel
408 Thread-14 (drive) South: 12 is leaving the tunnel
408 Thread-14 (drive) South: 12 is going back to the origin
411 Thread-10 (drive) South: 8 is waiting for the entrance permission
411 Thread-10 (drive) South: 8 is driving through the tunnel
412 Thread-5 (drive) South: 3 is leaving the tunnel
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412 Thread-5 (drive) South: 3 is going back to the origin
412 Thread-13 (drive) South: 11 is leaving the tunnel
412 Thread-13 (drive) South: 11 is going back to the origin
414 Thread-3 (drive) South: 1 is waiting for the entrance permission
414 Thread-3 (drive) South: 1 is driving through the tunnel
416 Thread-7 (drive) South: 5 is leaving the tunnel
416 Thread-7 (drive) South: 5 is going back to the origin
420 Thread-8 (drive) South: 6 is leaving the tunnel
421 Thread-8 (drive) South: 6 is going back to the origin
421 Thread-2 (drive) South: 0 is going to the tunnel entrance
423 Thread-6 (drive) South: 4 is waiting for the entrance permission
424 Thread-6 (drive) South: 4 is driving through the tunnel
427 Thread-14 (drive) South: 12 is going to the tunnel entrance
430 Thread-3 (drive) South: 1 is leaving the tunnel
430 Thread-3 (drive) South: 1 is going back to the origin
431 Thread-9 (drive) South: 7 is going to the tunnel entrance
431 Thread-5 (drive) South: 3 is going to the tunnel entrance
433 Thread-13 (drive) South: 11 is going to the tunnel entrance
434 Thread-14 (drive) South: 12 is waiting for the entrance permission
434 Thread-14 (drive) South: 12 is driving through the tunnel
437 Thread-12 (drive) South: 10 is waiting for the entrance permission
437 Thread-12 (drive) South: 10 is driving through the tunnel
440 Thread-6 (drive) South: 4 is leaving the tunnel
440 Thread-10 (drive) South: 8 is leaving the tunnel
441 Thread-6 (drive) South: 4 is going back to the origin
441 Thread-10 (drive) South: 8 is going back to the origin
441 Thread-8 (drive) South: 6 is going to the tunnel entrance
442 Thread-7 (drive) South: 5 is going to the tunnel entrance
442 Thread-11 (drive) South: 9 is leaving the tunnel
442 Thread-11 (drive) South: 9 is going back to the origin
448 Thread-11 (drive) South: 9 is going to the tunnel entrance
448 Thread-5 (drive) South: 3 is waiting for the entrance permission
448 Thread-5 (drive) South: 3 is driving through the tunnel
453 Thread-12 (drive) South: 10 is leaving the tunnel
454 Thread-12 (drive) South: 10 is going back to the origin
454 Thread-9 (drive) South: 7 is waiting for the entrance permission
454 Thread-9 (drive) South: 7 is driving through the tunnel
454 Thread-14 (drive) South: 12 is leaving the tunnel
454 Thread-14 (drive) South: 12 is going back to the origin
454 Thread-7 (drive) South: 5 is waiting for the entrance permission
454 Thread-7 (drive) South: 5 is driving through the tunnel
455 Thread-9 (drive) South: 7 is leaving the tunnel
455 Thread-9 (drive) South: 7 is going back to the origin
458 Thread-12 (drive) South: 10 is going to the tunnel entrance
462 Thread-3 (drive) South: 1 is going to the tunnel entrance
467 Thread-13 (drive) South: 11 is waiting for the entrance permission
468 Thread-13 (drive) South: 11 is driving through the tunnel
468 Thread-2 (drive) South: 0 is waiting for the entrance permission
468 Thread-2 (drive) South: 0 is driving through the tunnel
471 Thread-7 (drive) South: 5 is leaving the tunnel
471 Thread-7 (drive) South: 5 is going back to the origin
472 Thread-8 (drive) South: 6 is waiting for the entrance permission
472 Thread-8 (drive) South: 6 is driving through the tunnel
473 Thread-6 (drive) South: 4 is going to the tunnel entrance
475 Thread-9 (drive) South: 7 is going to the tunnel entrance
480 Thread-10 (drive) South: 8 is going to the tunnel entrance
481 Thread-11 (drive) South: 9 is waiting for the entrance permission
481 Thread-11 (drive) South: 9 is driving through the tunnel
481 Thread-13 (drive) South: 11 is leaving the tunnel
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481 Thread-13 (drive) South: 11 is going back to the origin
483 Thread-6 (drive) South: 4 is waiting for the entrance permission
483 Thread-6 (drive) South: 4 is driving through the tunnel
489 Thread-14 (drive) South: 12 is going to the tunnel entrance
490 Thread-3 (drive) South: 1 is waiting for the entrance permission
490 Thread-5 (drive) South: 3 is leaving the tunnel
490 Thread-12 (drive) South: 10 is waiting for the entrance permission
490 Thread-3 (drive) South: 1 is driving through the tunnel
491 Thread-6 (drive) South: 4 is leaving the tunnel
491 Thread-5 (drive) South: 3 is going back to the origin
491 Thread-12 (drive) South: 10 is driving through the tunnel
491 Thread-6 (drive) South: 4 is going back to the origin
492 Thread-12 (drive) South: 10 is leaving the tunnel
492 Thread-12 (drive) South: 10 is going back to the origin
494 Thread-2 (drive) South: 0 is leaving the tunnel
494 Thread-14 (drive) South: 12 is waiting for the entrance permission
494 Thread-2 (drive) South: 0 is going back to the origin
494 Thread-14 (drive) South: 12 is driving through the tunnel
496 Thread-14 (drive) South: 12 is leaving the tunnel
496 Thread-14 (drive) South: 12 is going back to the origin
500 Thread-6 (drive) South: 4 is going to the tunnel entrance
501 Thread-12 (drive) South: 10 is going to the tunnel entrance
504 Thread-5 (drive) South: 3 is going to the tunnel entrance
505 Thread-9 (drive) South: 7 is waiting for the entrance permission
505 Thread-9 (drive) South: 7 is driving through the tunnel
505 Thread-7 (drive) South: 5 is going to the tunnel entrance
512 Thread-2 (drive) South: 0 is going to the tunnel entrance
515 Thread-8 (drive) South: 6 is leaving the tunnel
515 Thread-8 (drive) South: 6 is going back to the origin
515 Thread-10 (drive) South: 8 is waiting for the entrance permission
515 Thread-11 (drive) South: 9 is leaving the tunnel
515 Thread-10 (drive) South: 8 is driving through the tunnel
515 Thread-11 (drive) South: 9 is going back to the origin
521 Thread-13 (drive) South: 11 is going to the tunnel entrance
525 Thread-5 (drive) South: 3 is waiting for the entrance permission
525 Thread-5 (drive) South: 3 is driving through the tunnel
527 Thread-12 (drive) South: 10 is waiting for the entrance permission
527 Thread-12 (drive) South: 10 is driving through the tunnel
529 Thread-7 (drive) South: 5 is waiting for the entrance permission
529 Thread-7 (drive) South: 5 is driving through the tunnel
535 Thread-9 (drive) South: 7 is leaving the tunnel
535 Thread-9 (drive) South: 7 is going back to the origin
537 Thread-3 (drive) South: 1 is leaving the tunnel
537 Thread-3 (drive) South: 1 is going back to the origin
538 Thread-6 (drive) South: 4 is waiting for the entrance permission
538 Thread-6 (drive) South: 4 is driving through the tunnel
541 Thread-2 (drive) South: 0 is waiting for the entrance permission
541 Thread-2 (drive) South: 0 is driving through the tunnel
542 Thread-10 (drive) South: 8 is leaving the tunnel
542 Thread-10 (drive) South: 8 is going back to the origin
549 Thread-6 (drive) South: 4 is leaving the tunnel
549 Thread-6 (drive) South: 4 is going back to the origin
553 Thread-9 (drive) South: 7 is going to the tunnel entrance
554 Thread-13 (drive) South: 11 is waiting for the entrance permission
554 Thread-13 (drive) South: 11 is driving through the tunnel
557 Thread-12 (drive) South: 10 is leaving the tunnel
557 Thread-12 (drive) South: 10 is going back to the origin
566 Thread-5 (drive) South: 3 is leaving the tunnel
567 Thread-5 (drive) South: 3 is going back to the origin
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570 Thread-13 (drive) South: 11 is leaving the tunnel
570 Thread-13 (drive) South: 11 is going back to the origin
570 Thread-3 (drive) South: 1 is going to the tunnel entrance
576 Thread-7 (drive) South: 5 is leaving the tunnel
576 Thread-7 (drive) South: 5 is going back to the origin
582 Thread-5 (drive) South: 3 is going to the tunnel entrance
583 Thread-3 (drive) South: 1 is waiting for the entrance permission
583 Thread-3 (drive) South: 1 is driving through the tunnel
583 Thread-10 (drive) South: 8 is going to the tunnel entrance
586 Thread-9 (drive) South: 7 is waiting for the entrance permission
586 Thread-9 (drive) South: 7 is driving through the tunnel
589 Thread-2 (drive) South: 0 is leaving the tunnel
589 Thread-2 (drive) South: 0 is going back to the origin
592 Thread-3 (drive) South: 1 is leaving the tunnel
592 Thread-3 (drive) South: 1 is going back to the origin
593 Thread-7 (drive) South: 5 is going to the tunnel entrance
600 Thread-5 (drive) South: 3 is waiting for the entrance permission
600 Thread-5 (drive) South: 3 is driving through the tunnel
608 Thread-10 (drive) South: 8 is waiting for the entrance permission
609 Thread-10 (drive) South: 8 is driving through the tunnel
610 Thread-2 (drive) South: 0 is going to the tunnel entrance
615 Thread-10 (drive) South: 8 is leaving the tunnel
615 Thread-10 (drive) South: 8 is going back to the origin
616 Thread-9 (drive) South: 7 is leaving the tunnel
616 Thread-9 (drive) South: 7 is going back to the origin
635 Thread-2 (drive) South: 0 is waiting for the entrance permission
635 Thread-2 (drive) South: 0 is driving through the tunnel
639 Thread-7 (drive) South: 5 is waiting for the entrance permission
639 Thread-7 (drive) South: 5 is driving through the tunnel
642 Thread-5 (drive) South: 3 is leaving the tunnel
642 Thread-5 (drive) South: 3 is going back to the origin
649 Thread-2 (drive) South: 0 is leaving the tunnel
649 Thread-2 (drive) South: 0 is going back to the origin
658 Thread-5 (drive) South: 3 is going to the tunnel entrance
671 Thread-7 (drive) South: 5 is leaving the tunnel
671 Thread-7 (drive) South: 5 is going back to the origin
689 MainThread South: 0 is getting out of the car
689 MainThread South: 1 is getting out of the car
689 MainThread South: 2 is getting out of the car
697 Thread-5 (drive) South: 3 is waiting for the entrance permission
697 Thread-5 (drive) South: 3 is driving through the tunnel
742 Thread-5 (drive) South: 3 is leaving the tunnel
742 Thread-5 (drive) South: 3 is going back to the origin
760 MainThread South: 3 is getting out of the car
760 MainThread South: 4 is getting out of the car
760 MainThread South: 5 is getting out of the car
760 MainThread South: 6 is getting out of the car
760 MainThread South: 7 is getting out of the car
760 MainThread South: 8 is getting out of the car
760 MainThread South: 9 is getting out of the car
760 MainThread South: 10 is getting out of the car
760 MainThread South: 11 is getting out of the car
760 MainThread South: 12 is getting out of the car
```

7

Run params: default

```
Lab04 - The one-lane tunnel simulation
29 cars going north, 31 cars going south, 23 cycles north, 19 cycles south, limit 5
The tunnel monitor
    11 MainThread North: 0 is jumping in the car
    11 MainThread North: 1 is jumping in the car
    11 MainThread North: 2 is jumping in the car
    11 MainThread North: 3 is jumping in the car
    11 MainThread North: 4 is jumping in the car
    11 MainThread North: 5 is jumping in the car
    11 MainThread North: 6 is jumping in the car
    12 MainThread North: 7 is jumping in the car
    12 MainThread North: 8 is jumping in the car
    12 MainThread North: 9 is jumping in the car
    12 MainThread North: 10 is jumping in the car
    12 MainThread North: 11 is jumping in the car
    12 MainThread North: 12 is jumping in the car
    12 MainThread North: 13 is jumping in the car
    12 MainThread North: 14 is jumping in the car
    12 MainThread North: 15 is jumping in the car
    13 MainThread North: 16 is jumping in the car
    13 MainThread North: 17 is jumping in the car
    13 MainThread North: 18 is jumping in the car
    13 MainThread North: 19 is jumping in the car
    13 MainThread North: 20 is jumping in the car
    13 MainThread North: 21 is jumping in the car
    13 MainThread North: 22 is jumping in the car
    13 MainThread North: 23 is jumping in the car
    13 MainThread North: 24 is jumping in the car
    13 MainThread North: 25 is jumping in the car
    13 MainThread North: 26 is jumping in the car
    14 MainThread North: 27 is jumping in the car
    14 MainThread North: 28 is jumping in the car
    14 MainThread South: 0 is jumping in the car
    14 MainThread South: 1 is jumping in the car
    14 MainThread South: 2 is jumping in the car
    14 MainThread South: 3 is jumping in the car
    14 MainThread South: 4 is jumping in the car
    14 MainThread South: 5 is jumping in the car
    14 MainThread South: 6 is jumping in the car
    14 MainThread South: 7 is jumping in the car
    14 MainThread South: 8 is jumping in the car
    15 MainThread South: 9 is jumping in the car
    15 MainThread South: 10 is jumping in the car
    15 MainThread South: 11 is jumping in the car
    15 MainThread South: 12 is jumping in the car
    15 MainThread South: 13 is jumping in the car
    15 MainThread South: 14 is jumping in the car
    15 MainThread South: 15 is jumping in the car
    15 MainThread South: 16 is jumping in the car
    15 MainThread South: 17 is jumping in the car
    15 MainThread South: 18 is jumping in the car
    15 MainThread South: 19 is jumping in the car
    15 MainThread South: 20 is jumping in the car
    16 MainThread South: 21 is jumping in the car
    16 MainThread South: 22 is jumping in the car
    16 MainThread South: 23 is jumping in the car
    16 MainThread South: 24 is jumping in the car
```

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16 MainThread South: 25 is jumping in the car
16 MainThread South: 26 is jumping in the car
16 MainThread South: 27 is jumping in the car
16 MainThread South: 28 is jumping in the car
16 MainThread South: 29 is jumping in the car
16 MainThread South: 30 is jumping in the car
17 Thread-4 (drive) North: 3 is going to the tunnel entrance
18 Thread-37 (drive) South: 7 is going to the tunnel entrance
18 Thread-38 (drive) South: 8 is going to the tunnel entrance
22 Thread-52 (drive) South: 22 is going to the tunnel entrance
24 Thread-43 (drive) South: 13 is going to the tunnel entrance
24 Thread-11 (drive) North: 10 is going to the tunnel entrance
24 Thread-49 (drive) South: 19 is going to the tunnel entrance
26 Thread-48 (drive) South: 18 is going to the tunnel entrance
26 Thread-2 (drive) North: 1 is going to the tunnel entrance
26 Thread-30 (drive) South: 0 is going to the tunnel entrance
32 Thread-43 (drive) South: 13 is waiting for the entrance permission
32 Thread-26 (drive) North: 25 is going to the tunnel entrance
32 Thread-55 (drive) South: 25 is going to the tunnel entrance
32 Thread-57 (drive) South: 27 is going to the tunnel entrance
32 Thread-28 (drive) North: 27 is going to the tunnel entrance
32 Thread-43 (drive) South: 13 is driving through the tunnel
33 Thread-17 (drive) North: 16 is going to the tunnel entrance
33 Thread-52 (drive) South: 22 is waiting for the entrance permission
33 Thread-42 (drive) South: 12 is going to the tunnel entrance
33 Thread-24 (drive) North: 23 is going to the tunnel entrance
34 Thread-4 (drive) North: 3 is waiting for the entrance permission
34 Thread-52 (drive) South: 22 is driving through the tunnel
34 Thread-3 (drive) North: 2 is going to the tunnel entrance
35 Thread-56 (drive) South: 26 is going to the tunnel entrance
35 Thread-5 (drive) North: 4 is going to the tunnel entrance
35 Thread-6 (drive) North: 5 is going to the tunnel entrance
36 Thread-11 (drive) North: 10 is waiting for the entrance permission
36 Thread-33 (drive) South: 3 is going to the tunnel entrance
37 Thread-16 (drive) North: 15 is going to the tunnel entrance
37 Thread-23 (drive) North: 22 is going to the tunnel entrance
39 Thread-43 (drive) South: 13 is leaving the tunnel
39 Thread-33 (drive) South: 3 is waiting for the entrance permission
40 Thread-54 (drive) South: 24 is going to the tunnel entrance
40 Thread-1 (drive) North: 0 is going to the tunnel entrance
40 Thread-44 (drive) South: 14 is going to the tunnel entrance
40 Thread-3 (drive) North: 2 is waiting for the entrance permission
40 Thread-32 (drive) South: 2 is going to the tunnel entrance
40 Thread-43 (drive) South: 13 is going back to the origin
40 Thread-33 (drive) South: 3 is driving through the tunnel
40 Thread-42 (drive) South: 12 is waiting for the entrance permission
41 Thread-12 (drive) North: 11 is going to the tunnel entrance
42 Thread-9 (drive) North: 8 is going to the tunnel entrance
42 Thread-42 (drive) South: 12 is driving through the tunnel
42 Thread-46 (drive) South: 16 is going to the tunnel entrance
42 Thread-17 (drive) North: 16 is waiting for the entrance permission
42 Thread-13 (drive) North: 12 is going to the tunnel entrance
42 Thread-19 (drive) North: 18 is going to the tunnel entrance
43 Thread-47 (drive) South: 17 is going to the tunnel entrance
44 Thread-29 (drive) North: 28 is going to the tunnel entrance
44 Thread-36 (drive) South: 6 is going to the tunnel entrance
44 Thread-26 (drive) North: 25 is waiting for the entrance permission
46 Thread-5 (drive) North: 4 is waiting for the entrance permission
46 Thread-40 (drive) South: 10 is going to the tunnel entrance
```

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46 Thread-59 (drive) South: 29 is going to the tunnel entrance
46 Thread-31 (drive) South: 1 is going to the tunnel entrance
46 Thread-37 (drive) South: 7 is waiting for the entrance permission
47 Thread-37 (drive) South: 7 is driving through the tunnel
47 Thread-27 (drive) North: 26 is going to the tunnel entrance
47 Thread-7 (drive) North: 6 is going to the tunnel entrance
47 Thread-51 (drive) South: 21 is going to the tunnel entrance
52 Thread-8 (drive) North: 7 is going to the tunnel entrance
52 Thread-39 (drive) South: 9 is going to the tunnel entrance
52 Thread-14 (drive) North: 13 is going to the tunnel entrance
52 Thread-22 (drive) North: 21 is going to the tunnel entrance
52 Thread-43 (drive) South: 13 is going to the tunnel entrance
55 Thread-7 (drive) North: 6 is waiting for the entrance permission
55 Thread-23 (drive) North: 22 is waiting for the entrance permission
55 Thread-34 (drive) South: 4 is going to the tunnel entrance
55 Thread-45 (drive) South: 15 is going to the tunnel entrance
55 Thread-50 (drive) South: 20 is going to the tunnel entrance
55 Thread-25 (drive) North: 24 is going to the tunnel entrance
55 Thread-18 (drive) North: 17 is going to the tunnel entrance
55 Thread-2 (drive) North: 1 is waiting for the entrance permission
56 Thread-21 (drive) North: 20 is going to the tunnel entrance
56 Thread-60 (drive) South: 30 is going to the tunnel entrance
56 Thread-10 (drive) North: 9 is going to the tunnel entrance
56 Thread-27 (drive) North: 26 is waiting for the entrance permission
56 Thread-13 (drive) North: 12 is waiting for the entrance permission
56 Thread-15 (drive) North: 14 is going to the tunnel entrance
58 Thread-35 (drive) South: 5 is going to the tunnel entrance
58 Thread-8 (drive) North: 7 is waiting for the entrance permission
58 Thread-58 (drive) South: 28 is going to the tunnel entrance
59 Thread-20 (drive) North: 19 is going to the tunnel entrance
59 Thread-44 (drive) South: 14 is waiting for the entrance permission
59 Thread-49 (drive) South: 19 is waiting for the entrance permission
60 Thread-44 (drive) South: 14 is driving through the tunnel
60 Thread-49 (drive) South: 19 is driving through the tunnel
63 Thread-21 (drive) North: 20 is waiting for the entrance permission
63 Thread-53 (drive) South: 23 is going to the tunnel entrance
63 Thread-41 (drive) South: 11 is going to the tunnel entrance
63 Thread-38 (drive) South: 8 is waiting for the entrance permission
63 Thread-36 (drive) South: 6 is waiting for the entrance permission
64 Thread-51 (drive) South: 21 is waiting for the entrance permission
67 Thread-47 (drive) South: 17 is waiting for the entrance permission
67 Thread-14 (drive) North: 13 is waiting for the entrance permission
68 Thread-50 (drive) South: 20 is waiting for the entrance permission
68 Thread-30 (drive) South: 0 is waiting for the entrance permission
68 Thread-16 (drive) North: 15 is waiting for the entrance permission
71 Thread-24 (drive) North: 23 is waiting for the entrance permission
71 Thread-52 (drive) South: 22 is leaving the tunnel
71 Thread-40 (drive) South: 10 is waiting for the entrance permission
71 Thread-48 (drive) South: 18 is waiting for the entrance permission
71 Thread-58 (drive) South: 28 is waiting for the entrance permission
71 Thread-44 (drive) South: 14 is leaving the tunnel
71 Thread-55 (drive) South: 25 is waiting for the entrance permission
71 Thread-9 (drive) North: 8 is waiting for the entrance permission
71 Thread-59 (drive) South: 29 is waiting for the entrance permission
72 Thread-52 (drive) South: 22 is going back to the origin
73 Thread-44 (drive) South: 14 is going back to the origin
76 Thread-57 (drive) South: 27 is waiting for the entrance permission
76 Thread-31 (drive) South: 1 is waiting for the entrance permission
76 Thread-56 (drive) South: 26 is waiting for the entrance permission
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 78 Thread-29 (drive) North: 28 is waiting for the entrance permission
 78 Thread-43 (drive) South: 13 is waiting for the entrance permission
 79 Thread-32 (drive) South: 2 is waiting for the entrance permission
 79 Thread-35 (drive) South: 5 is waiting for the entrance permission
 79 Thread-42 (drive) South: 12 is leaving the tunnel
 79 Thread-42 (drive) South: 12 is going back to the origin
 80 Thread-6 (drive) North: 5 is waiting for the entrance permission
 80 Thread-28 (drive) North: 27 is waiting for the entrance permission
 80 Thread-39 (drive) South: 9 is waiting for the entrance permission
 80 Thread-10 (drive) North: 9 is waiting for the entrance permission
 80 Thread-46 (drive) South: 16 is waiting for the entrance permission
 81 Thread-1 (drive) North: 0 is waiting for the entrance permission
 81 Thread-33 (drive) South: 3 is leaving the tunnel
 81 Thread-60 (drive) South: 30 is waiting for the entrance permission
 81 Thread-18 (drive) North: 17 is waiting for the entrance permission
 81 Thread-12 (drive) North: 11 is waiting for the entrance permission
 81 Thread-45 (drive) South: 15 is waiting for the entrance permission
 82 Thread-33 (drive) South: 3 is going back to the origin
 82 Thread-37 (drive) South: 7 is leaving the tunnel
 82 Thread-53 (drive) South: 23 is waiting for the entrance permission
 83 Thread-37 (drive) South: 7 is going back to the origin
 85 Thread-33 (drive) South: 3 is going to the tunnel entrance
 89 Thread-44 (drive) South: 14 is going to the tunnel entrance
 89 Thread-15 (drive) North: 14 is waiting for the entrance permission
 92 Thread-19 (drive) North: 18 is waiting for the entrance permission

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#######################..... 6202 lines skipped ......#########################
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 10281 Thread-1 (drive) North: 0 is going to the tunnel entrance
 10282 Thread-26 (drive) North: 25 is waiting for the entrance permission
 10283 Thread-32 (drive) South: 2 is leaving the tunnel
 10283 Thread-32 (drive) South: 2 is going back to the origin
 10283 Thread-11 (drive) North: 10 is driving through the tunnel
 10283 Thread-29 (drive) North: 28 is driving through the tunnel
 10283 Thread-14 (drive) North: 13 is driving through the tunnel
 10283 Thread-17 (drive) North: 16 is driving through the tunnel
 10283 Thread-27 (drive) North: 26 is driving through the tunnel
 10284 Thread-7 (drive) North: 6 is waiting for the entrance permission
 10284 Thread-24 (drive) North: 23 is driving through the tunnel
 10284 Thread-23 (drive) North: 22 is driving through the tunnel
 10284 Thread-26 (drive) North: 25 is driving through the tunnel
 10285 Thread-7 (drive) North: 6 is driving through the tunnel
 10289 Thread-17 (drive) North: 16 is leaving the tunnel
 10289 Thread-17 (drive) North: 16 is going back to the origin
 10289 Thread-19 (drive) North: 18 is waiting for the entrance permission
 10289 Thread-19 (drive) North: 18 is driving through the tunnel
 10291 Thread-1 (drive) North: 0 is waiting for the entrance permission
 10291 Thread-1 (drive) North: 0 is driving through the tunnel
 10293 Thread-7 (drive) North: 6 is leaving the tunnel
 10293 Thread-7 (drive) North: 6 is going back to the origin
 10295 Thread-17 (drive) North: 16 is going to the tunnel entrance
 10297 Thread-29 (drive) North: 28 is leaving the tunnel
 10297 Thread-29 (drive) North: 28 is going back to the origin
 10304 Thread-26 (drive) North: 25 is leaving the tunnel
 10304 Thread-26 (drive) North: 25 is going back to the origin
 10304 Thread-14 (drive) North: 13 is leaving the tunnel
 10305 Thread-14 (drive) North: 13 is going back to the origin
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10306 Thread-11 (drive) North: 10 is leaving the tunnel
10306 Thread-11 (drive) North: 10 is going back to the origin
10307 Thread-29 (drive) North: 28 is going to the tunnel entrance
10312 Thread-24 (drive) North: 23 is leaving the tunnel
10312 Thread-24 (drive) North: 23 is going back to the origin
10312 Thread-17 (drive) North: 16 is waiting for the entrance permission
10312 Thread-17 (drive) North: 16 is driving through the tunnel
10317 Thread-23 (drive) North: 22 is leaving the tunnel
10317 Thread-23 (drive) North: 22 is going back to the origin
10322 Thread-7 (drive) North: 6 is going to the tunnel entrance
10326 Thread-27 (drive) North: 26 is leaving the tunnel
10326 Thread-27 (drive) North: 26 is going back to the origin
10327 Thread-1 (drive) North: 0 is leaving the tunnel
10327 Thread-1 (drive) North: 0 is going back to the origin
10328 Thread-19 (drive) North: 18 is leaving the tunnel
10328 Thread-19 (drive) North: 18 is going back to the origin
10332 Thread-23 (drive) North: 22 is going to the tunnel entrance
10337 Thread-29 (drive) North: 28 is waiting for the entrance permission
10337 Thread-29 (drive) North: 28 is driving through the tunnel
10341 Thread-24 (drive) North: 23 is going to the tunnel entrance
10344 Thread-7 (drive) North: 6 is waiting for the entrance permission
10344 Thread-7 (drive) North: 6 is driving through the tunnel
10347 Thread-11 (drive) North: 10 is going to the tunnel entrance
10352 Thread-17 (drive) North: 16 is leaving the tunnel
10352 Thread-17 (drive) North: 16 is going back to the origin
10353 Thread-24 (drive) North: 23 is waiting for the entrance permission
10353 Thread-24 (drive) North: 23 is driving through the tunnel
10353 Thread-23 (drive) North: 22 is waiting for the entrance permission
10353 Thread-23 (drive) North: 22 is driving through the tunnel
10353 Thread-1 (drive) North: 0 is going to the tunnel entrance
10354 Thread-29 (drive) North: 28 is leaving the tunnel
10354 Thread-29 (drive) North: 28 is going back to the origin
10359 Thread-27 (drive) North: 26 is going to the tunnel entrance
10359 Thread-17 (drive) North: 16 is going to the tunnel entrance
10359 Thread-7 (drive) North: 6 is leaving the tunnel
10359 Thread-7 (drive) North: 6 is going back to the origin
10361 Thread-11 (drive) North: 10 is waiting for the entrance permission
10361 Thread-11 (drive) North: 10 is driving through the tunnel
10362 Thread-19 (drive) North: 18 is going to the tunnel entrance
10368 Thread-23 (drive) North: 22 is leaving the tunnel
10369 Thread-23 (drive) North: 22 is going back to the origin
10379 Thread-23 (drive) North: 22 is going to the tunnel entrance
10379 Thread-1 (drive) North: 0 is waiting for the entrance permission
10379 Thread-1 (drive) North: 0 is driving through the tunnel
10382 Thread-1 (drive) North: 0 is leaving the tunnel
10382 Thread-1 (drive) North: 0 is going back to the origin
10383 Thread-17 (drive) North: 16 is waiting for the entrance permission
10383 Thread-17 (drive) North: 16 is driving through the tunnel
10383 Thread-27 (drive) North: 26 is waiting for the entrance permission
10384 Thread-27 (drive) North: 26 is driving through the tunnel
10387 Thread-17 (drive) North: 16 is leaving the tunnel
10387 Thread-17 (drive) North: 16 is going back to the origin
10389 Thread-11 (drive) North: 10 is leaving the tunnel
10389 Thread-11 (drive) North: 10 is going back to the origin
10394 Thread-19 (drive) North: 18 is waiting for the entrance permission
10394 Thread-19 (drive) North: 18 is driving through the tunnel
10394 Thread-24 (drive) North: 23 is leaving the tunnel
10394 Thread-24 (drive) North: 23 is going back to the origin
10399 Thread-1 (drive) North: 0 is going to the tunnel entrance
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10399 Thread-23 (drive) North: 22 is waiting for the entrance permission
10399 Thread-23 (drive) North: 22 is driving through the tunnel
10405 Thread-24 (drive) North: 23 is going to the tunnel entrance
10416 Thread-23 (drive) North: 22 is leaving the tunnel
10416 Thread-23 (drive) North: 22 is going back to the origin
10416 Thread-11 (drive) North: 10 is going to the tunnel entrance
10422 Thread-1 (drive) North: 0 is waiting for the entrance permission
10422 Thread-1 (drive) North: 0 is driving through the tunnel
10423 Thread-19 (drive) North: 18 is leaving the tunnel
10424 Thread-19 (drive) North: 18 is going back to the origin
10430 Thread-27 (drive) North: 26 is leaving the tunnel
10430 Thread-27 (drive) North: 26 is going back to the origin
10437 Thread-23 (drive) North: 22 is going to the tunnel entrance
10437 Thread-24 (drive) North: 23 is waiting for the entrance permission
10438 Thread-24 (drive) North: 23 is driving through the tunnel
10444 Thread-11 (drive) North: 10 is waiting for the entrance permission
10444 Thread-11 (drive) North: 10 is driving through the tunnel
10449 Thread-11 (drive) North: 10 is leaving the tunnel
10449 Thread-11 (drive) North: 10 is going back to the origin
10451 Thread-23 (drive) North: 22 is waiting for the entrance permission
10452 Thread-23 (drive) North: 22 is driving through the tunnel
10452 Thread-1 (drive) North: 0 is leaving the tunnel
10452 Thread-1 (drive) North: 0 is going back to the origin
10452 Thread-11 (drive) North: 10 is going to the tunnel entrance
10459 Thread-24 (drive) North: 23 is leaving the tunnel
10459 Thread-24 (drive) North: 23 is going back to the origin
10470 Thread-24 (drive) North: 23 is going to the tunnel entrance
10481 Thread-11 (drive) North: 10 is waiting for the entrance permission
10481 Thread-11 (drive) North: 10 is driving through the tunnel
10481 Thread-23 (drive) North: 22 is leaving the tunnel
10482 Thread-23 (drive) North: 22 is going back to the origin
10487 Thread-1 (drive) North: 0 is going to the tunnel entrance
10499 Thread-1 (drive) North: 0 is waiting for the entrance permission
10499 Thread-1 (drive) North: 0 is driving through the tunnel
10505 Thread-1 (drive) North: 0 is leaving the tunnel
10506 Thread-1 (drive) North: 0 is going back to the origin
10506 Thread-24 (drive) North: 23 is waiting for the entrance permission
10506 Thread-24 (drive) North: 23 is driving through the tunnel
10506 Thread-11 (drive) North: 10 is leaving the tunnel
10507 Thread-11 (drive) North: 10 is going back to the origin
10517 MainThread North: 0 is getting out of the car
10517 MainThread North: 1 is getting out of the car
10518 MainThread North: 2 is getting out of the car
10518 MainThread North: 3 is getting out of the car
10518 MainThread North: 4 is getting out of the car
10518 MainThread North: 5 is getting out of the car
10518 MainThread North: 6 is getting out of the car
10518 MainThread North: 7 is getting out of the car
10518 MainThread North: 8 is getting out of the car
10518 MainThread North: 9 is getting out of the car
10524 Thread-24 (drive) North: 23 is leaving the tunnel
10524 Thread-24 (drive) North: 23 is going back to the origin
10529 MainThread North: 10 is getting out of the car
10530 MainThread North: 11 is getting out of the car
10530 MainThread North: 12 is getting out of the car
10530 MainThread North: 13 is getting out of the car
10530 MainThread North: 14 is getting out of the car
10530 MainThread North: 15 is getting out of the car
10530 MainThread North: 16 is getting out of the car
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10530 MainThread North: 17 is getting out of the car
10530 MainThread North: 18 is getting out of the car
10530 MainThread North: 19 is getting out of the car
10530 MainThread North: 20 is getting out of the car
10531 MainThread North: 21 is getting out of the car
10531 MainThread North: 22 is getting out of the car
10553 Thread-24 (drive) North: 23 is going to the tunnel entrance
10578 Thread-24 (drive) North: 23 is waiting for the entrance permission
10578 Thread-24 (drive) North: 23 is driving through the tunnel
10604 Thread-24 (drive) North: 23 is leaving the tunnel
10604 Thread-24 (drive) North: 23 is going back to the origin
10630 Thread-24 (drive) North: 23 is going to the tunnel entrance
10647 Thread-24 (drive) North: 23 is waiting for the entrance permission
10648 Thread-24 (drive) North: 23 is driving through the tunnel
10684 Thread-24 (drive) North: 23 is leaving the tunnel
10684 Thread-24 (drive) North: 23 is going back to the origin
10726 MainThread North: 23 is getting out of the car
10727 MainThread North: 24 is getting out of the car
10727 MainThread North: 25 is getting out of the car
10727 MainThread North: 26 is getting out of the car
10727 MainThread North: 27 is getting out of the car
10727 MainThread North: 28 is getting out of the car
10727 MainThread South: 0 is getting out of the car
10727 MainThread South: 1 is getting out of the car
10727 MainThread South: 2 is getting out of the car
10727 MainThread South: 3 is getting out of the car
10727 MainThread South: 4 is getting out of the car
10727 MainThread South: 5 is getting out of the car
10727 MainThread South: 6 is getting out of the car
10728 MainThread South: 7 is getting out of the car
10728 MainThread South: 8 is getting out of the car
10728 MainThread South: 9 is getting out of the car
10728 MainThread South: 10 is getting out of the car
10728 MainThread South: 11 is getting out of the car
10728 MainThread South: 12 is getting out of the car
10728 MainThread South: 13 is getting out of the car
10728 MainThread South: 14 is getting out of the car
10728 MainThread South: 15 is getting out of the car
10728 MainThread South: 16 is getting out of the car
10728 MainThread South: 17 is getting out of the car
10728 MainThread South: 18 is getting out of the car
10728 MainThread South: 19 is getting out of the car
10728 MainThread South: 20 is getting out of the car
10728 MainThread South: 21 is getting out of the car
10728 MainThread South: 22 is getting out of the car
10728 MainThread South: 23 is getting out of the car
10729 MainThread South: 24 is getting out of the car
10729 MainThread South: 25 is getting out of the car
10729 MainThread South: 26 is getting out of the car
10729 MainThread South: 27 is getting out of the car
10729 MainThread South: 28 is getting out of the car
10729 MainThread South: 29 is getting out of the car
10729 MainThread South: 30 is getting out of the car
```

The one-lane tunnel

This is the fifth TP of the lesson "Concurrent system". In this exercise we need to use a monitor to simulate a one-lane tunnel. This tunnel must be fair and avoid collision. The guideline is available here.

This project is made by @Simon.barras

Launch app

```
python3 .\lab04\src\tunnel.py -h
usage: tunnel.py [-h] [-N >= 0] [-S >= 0] [-n >= 1] [-s >= 1] [-L >= 1]

Simulation of a one-lane tunnel.

optional arguments:
  -h, --help  show this help message and exit
  -N >= 0     Number of cars going north
  -S >= 0     Number of cars going south
  -n >= 1     Number of time a car going north
  -s >= 1     Number of time a car going south
  -L >= 1     Max number of cars going in the same direction
```

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argument	description	range	default
tunnel.py	name of the python program file that contains the main entry point		
-N	The number of north bound vehicles	0	29
-n	The number of iterations north bound vehicles go through the tunnel	1	23
-S	The number of south bound vehicles	0	31
-s	The number of iterations south bound vehicles go through the tunnel	1	19
-L	Limit: if are vehicles waiting in the opposite direction, allow at most Limit vehicles to enter the bridge, and then change direction (this is to allow fairness)	1	5

Tunnel

The code is commented but I want to explain the purpose of this file.

This file is the main entry of the program, it contains the main function and

he try to parse the arguments. If the arguments are not correct, the program will print the help message and exit and the error message is modified for the argument with somes classes.
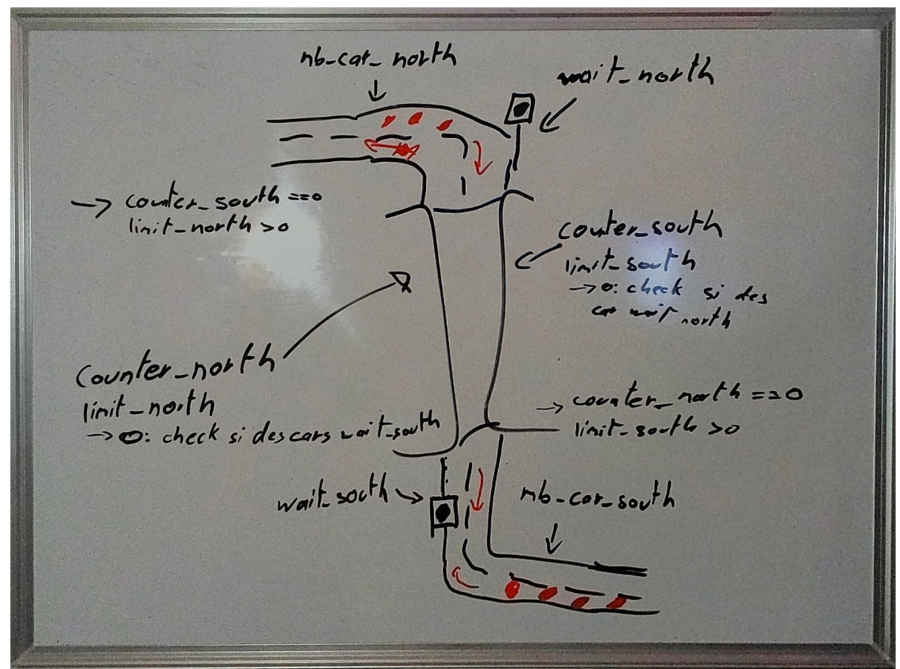
TunnelMonitor

This file contains the monitor and the vehicle class. This 2 class are used to simulate the tunnel, that say that all methods to access to the monitor or modify the state of the car are here.

Monitor

To complete the due, we need to create a monitor who can check if a car cann pass or not. Personnaly, I use 2 conditionnal variables for each entry. The first one is the number of car in the tunnel of a side and the second is the number of car before the tunnel will force change direction. We store the number of waiting car for each side.

To help me to think about the problem, I ve draw the sittuation and writed the

condition on my whiteboard.

Each time a car would enter the tunnel, we add 1 to the number of waiting car and we check if the opposite counter is 0 and his bounde limit is greater than 0. When the car can pass, we remove one to the waitting car and we reset the

opposite limit. We check if some car are waitting in the oder side. If yes, we remove 1 from the limit and if no, we notify all thread in this side.

Test

I have write some tests to evaluate my program with different critical values.

They all passed successfully !

Conclusion

That was a very interesting lab and I'm always happy to work on little simulation. I found this one pretty difficult to understand and to deal with monitor but now I think I'm able to explain monitor to someone else. There is one thing I've not been able is to fix and this is that car aren't overtaking in the tunnel. I speak with others students and we see thaht we need to use a different type of monitor to manage this point.

yes thats correct.