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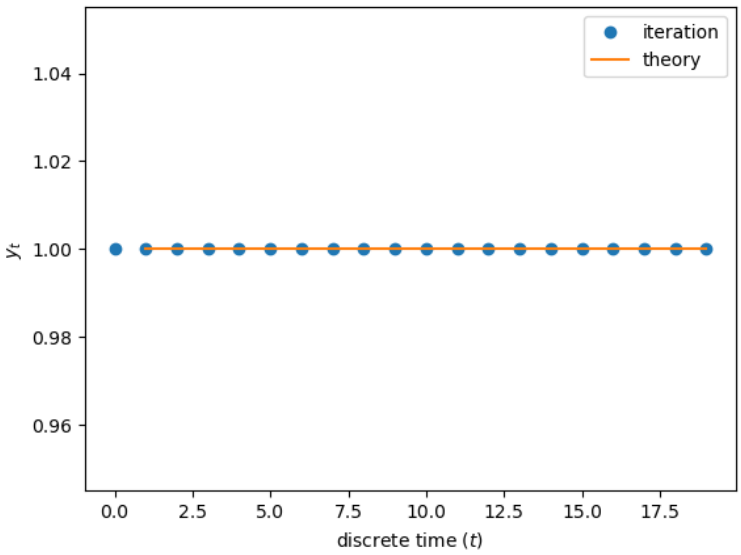
**問 2.1.1 + 問 2.1.2**

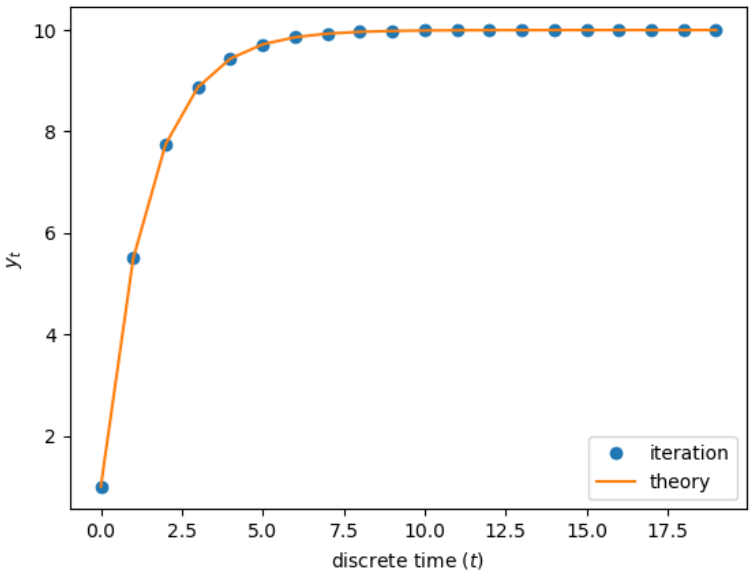
問 2.1.1

1. a = 2, c = -1

```
import numpy as np
import matplotlib.pyplot as plt


def generate(t):
    a = 2
    x = x_1 = 1.0
    xs = [x_1]
    for i in range(1, t):
        x = a * x - 1
        xs.append(x)
    return np.array(xs)

xs = generate(20)
ts = np.arange(20)
plt.xlabel("discrete time ($t$)")
plt.ylabel("$y_t$")
plt.plot(ts, xs, 'o', label="iteration")
plt.plot(ts, ts/ts, label="theory")
plt.legend()
plt.show()
```

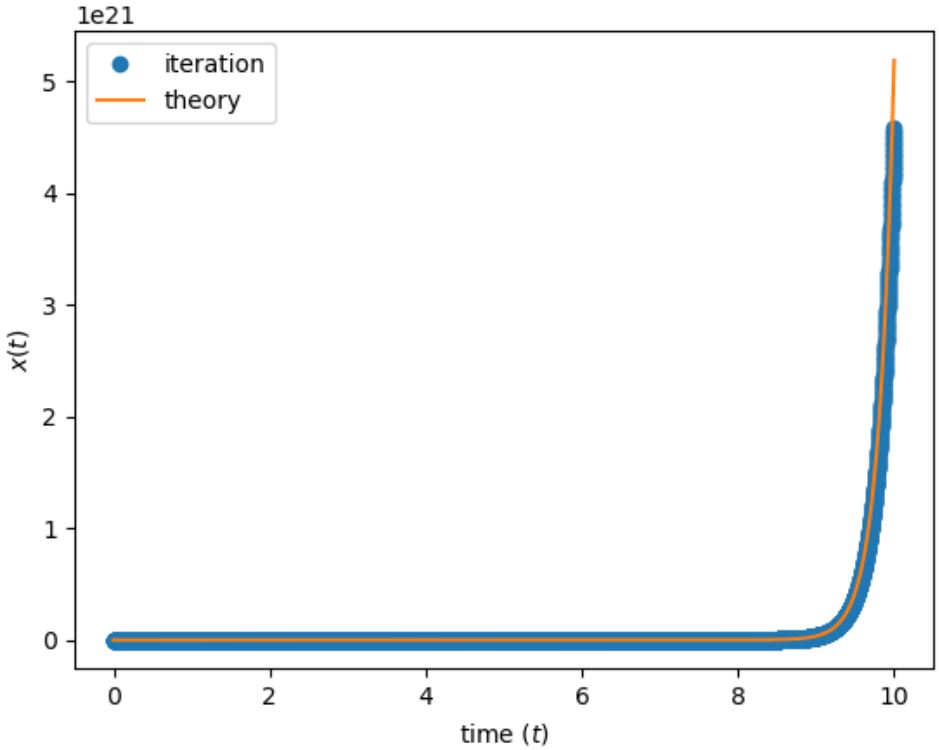


2. a = 1/2, c = 5
3. 
```
import numpy as np
import matplotlib.pyplot as plt


def generate(t):
    a = 1/2
    x = x_1 = 1.0
    xs = [x_1]
    for i in range(1, t):
        x = a * x + 5
        xs.append(x)
    return np.array(xs)

xs = generate(20)
ts = np.arange(20)
plt.xlabel("discrete time ($t$)")
plt.ylabel("$y_t$")
plt.plot(ts, xs, 'o', label="iteration")
plt.plot(ts, 10-9*0.5**ts, label="theory")
plt.legend()
plt.show()
```



問 2.1.2

```
import numpy as np
import math
import matplotlib.pyplot as plt


def F(x,t):
    return 5 * x

def generate(t_fin):
    x = x_1 = 1.0
    xs = []
    N_steps = 10000
    ts = np.linspace(0,t_fin,N_steps)
    dt = ts[1] - ts[0]
    for t in ts:
        xs.append(x)
        x = x + F(x,t) * dt
    return ts,np.array(xs)

ts,xs = generate(10.0)
plt.xlabel("time ($t$)")
plt.ylabel("$x(t)$")
plt.plot(ts, xs, 'o', label="iteration")
plt.plot(ts, np.exp(5 * ts), label="theory")
plt.legend()
plt.show()
```


1e21
iteration
theory
5
4
3
2
1
0
x(t)
0
2
4
6
8
10
time (t)