Topic Models

Machine Learning: Jordan Boyd-Graber
University of Colorado Boulder
LECTURE 18B

Content Questions

Content Questions

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Administrivia

- Project proposals in (feedback)
- LDA HW released
- No class next Wed

Sampling Token A

Assignments

$\text{Doc}_0 : z_A = 0, z_B = 1, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger dog iron pig
Topic 1 :pig hamburger iron cat
Topic 2 :dog iron cat

Sampling Token A

Assignments

$\text{Doc}_0 : z_A = 0, z_B = 1, z_C = 2, z_D = 0$
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Topics

Topic 0 :hamburger dog iron pig
Topic 1 :pig hamburger iron cat
Topic 2 :dog iron cat

- $p(z_{0,0} = 0) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.333 \times 0.125 = 0.042 = 0.042$

Sampling Token A

Assignments

$\text{Doc}_0 : z_A = 0, z_B = 1, z_C = 2, z_D = 0$
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Topics

Topic 0 :hamburger dog iron pig
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- $p(z_{0,0} = 0) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.333 \times 0.125 = 0.042 = 0.042$
- $p(z_{0,0} = 1) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{4+5.000}\right) = 0.333 \times 0.111 = 0.037 = 0.037$

Sampling Token A

Assignments

$\text{Doc}_0 : z_A = 0, z_B = 1, z_C = 2, z_D = 0$
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Topics

Topic 0 :hamburger dog iron pig
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- $p(z_{0,0} = 0) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.333 \times 0.125 = 0.042 = 0.042$
- $p(z_{0,0} = 1) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{4+5.000}\right) = 0.333 \times 0.111 = 0.037 = 0.037$
- $p(z_{0,0} = 2) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.333 \times 0.250 = 0.083 = 0.083$

Sampling Token A

Assignments

$\text{Doc}_0 : z_A = 0, z_B = 1, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger dog iron pig
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- $p(z_{0,0} = 1) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{4+5.000}\right) = 0.333 \times 0.111 = 0.037 = 0.037$
- $p(z_{0,0} = 2) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.333 \times 0.250 = 0.083 = 0.083$

Sampling Token A

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$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger dog iron pig
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- $p(z_{0,0} = 0) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.333 \times 0.125 = 0.042 = 0.042$
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- $p(z_{0,0} = 2) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.333 \times 0.250 = 0.083 = 0.083$

New assignment for (0, 0): 2

Sampling Token B

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 1, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron cat
Topic 2 :dog dog iron cat

Sampling Token B

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 1, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron cat
Topic 2 :dog dog iron cat

- $p(z_{0,1} = 0) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.333 \times 0.125 = 0.042 = 0.042$

Sampling Token B

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 1, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron cat
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- $p(z_{0,1} = 0) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.333 \times 0.125 = 0.042 = 0.042$
- $p(z_{0,1} = 1) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$

Sampling Token B

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 1, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
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Topics

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Topic 1 :pig hamburger iron cat
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- $p(z_{0,1} = 1) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{0,1} = 2) = \left(\frac{2+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{4+5.000}\right) = 0.500 \times 0.222 = 0.111 = 0.111$

Sampling Token B

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 1, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
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Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron cat
Topic 2 :dog dog iron cat

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- $p(z_{0,1} = 2) = \left(\frac{2+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{4+5.000}\right) = 0.500 \times 0.222 = 0.111 = 0.111$

New assignment for (0, 1): 2

Sampling Token C

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

Sampling Token C

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

- $p(z_{0,2} = 0) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.333 \times 0.125 = 0.042 = 0.042$

Sampling Token C

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

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$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
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Sampling Token C

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
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$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

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New assignment for (0, 2): 2

Sampling Token D

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

Sampling Token D

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

- $p(z_{0,3} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.167 \times 0.143 = 0.024 = 0.024$

Sampling Token D

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

- $p(z_{0,3} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.167 \times 0.143 = 0.024 = 0.024$
- $p(z_{0,3} = 1) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.167 \times 0.250 = 0.042 = 0.042$

Sampling Token D

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

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Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

- $p(z_{0,3} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.167 \times 0.143 = 0.024 = 0.024$
- $p(z_{0,3} = 1) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.167 \times 0.250 = 0.042 = 0.042$
- $p(z_{0,3} = 2) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{5+5.000}\right) = 0.667 \times 0.100 = 0.067 = 0.067$

Sampling Token D

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

- $p(z_{0,3} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.167 \times 0.143 = 0.024 = 0.024$
- $p(z_{0,3} = 1) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.167 \times 0.250 = 0.042 = 0.042$
- $p(z_{0,3} = 2) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{5+5.000}\right) = 0.667 \times 0.100 = 0.067 = 0.067$

Sampling Token D

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 0$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron pig
Topic 1 :pig hamburger iron
Topic 2 :dog dog iron cat cat

- $p(z_{0,3} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.167 \times 0.143 = 0.024 = 0.024$
- $p(z_{0,3} = 1) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.167 \times 0.250 = 0.042 = 0.042$
- $p(z_{0,3} = 2) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{5+5.000}\right) = 0.667 \times 0.100 = 0.067 = 0.067$

New assignment for (0, 3): 2

Sampling Token E

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron
Topic 1 :pig hamburger iron
Topic 2 :pig dog dog iron cat cat

Sampling Token E

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron
Topic 1 :pig hamburger iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,0} = 0) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.400 \times 0.286 = 0.114 = 0.114$

Sampling Token E

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron
Topic 1 :pig hamburger iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,0} = 0) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.400 \times 0.286 = 0.114 = 0.114$
- $p(z_{1,0} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$

Sampling Token E

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron
Topic 1 :pig hamburger iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,0} = 0) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.400 \times 0.286 = 0.114 = 0.114$
- $p(z_{1,0} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,0} = 2) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{6+5.000}\right) = 0.400 \times 0.091 = 0.036 = 0.036$

Sampling Token E

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron
Topic 1 :pig hamburger iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,0} = 0) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.400 \times 0.286 = 0.114 = 0.114$
- $p(z_{1,0} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,0} = 2) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{6+5.000}\right) = 0.400 \times 0.091 = 0.036 = 0.036$

Sampling Token E

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 1, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger iron
Topic 1 :pig hamburger iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,0} = 0) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.400 \times 0.286 = 0.114 = 0.114$
- $p(z_{1,0} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,0} = 2) = \left(\frac{1+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{6+5.000}\right) = 0.400 \times 0.091 = 0.036 = 0.036$

New assignment for (1, 0): 0

Sampling Token F

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger iron
Topic 1 :pig iron
Topic 2 :pig dog dog iron cat cat

Sampling Token F

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger iron
Topic 1 :pig iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,1} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.600 \times 0.125 = 0.075 = 0.075$

Sampling Token F

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger iron
Topic 1 :pig iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,1} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.600 \times 0.125 = 0.075 = 0.075$
- $p(z_{1,1} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$

Sampling Token F

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger iron
Topic 1 :pig iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,1} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.600 \times 0.125 = 0.075 = 0.075$
- $p(z_{1,1} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,1} = 2) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{5+5.000}\right) = 0.200 \times 0.200 = 0.040 = 0.040$

Sampling Token F

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger iron
Topic 1 :pig iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,1} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.600 \times 0.125 = 0.075 = 0.075$
- $p(z_{1,1} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,1} = 2) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{5+5.000}\right) = 0.200 \times 0.200 = 0.040 = 0.040$

Sampling Token F

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 2, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger iron
Topic 1 :pig iron
Topic 2 :pig dog dog iron cat cat

- $p(z_{1,1} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.600 \times 0.125 = 0.075 = 0.075$
- $p(z_{1,1} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,1} = 2) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{5+5.000}\right) = 0.200 \times 0.200 = 0.040 = 0.040$

New assignment for (1, 1): 0

Sampling Token G

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

Sampling Token G

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{1,2} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.600 \times 0.250 = 0.150 = 0.150$

Sampling Token G

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{1,2} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.600 \times 0.250 = 0.150 = 0.150$
- $p(z_{1,2} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$

Sampling Token G

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{1,2} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.600 \times 0.250 = 0.150 = 0.150$
- $p(z_{1,2} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,2} = 2) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{5+5.000}\right) = 0.200 \times 0.100 = 0.020 = 0.020$

Sampling Token G

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{1,2} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.600 \times 0.250 = 0.150 = 0.150$
- $p(z_{1,2} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,2} = 2) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{5+5.000}\right) = 0.200 \times 0.100 = 0.020 = 0.020$

Sampling Token G

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{1,2} = 0) = \left(\frac{2+1.000}{2+3.000}\right) \times \left(\frac{1+1.000}{3+5.000}\right) = 0.600 \times 0.250 = 0.150 = 0.150$
- $p(z_{1,2} = 1) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{2+5.000}\right) = 0.200 \times 0.143 = 0.029 = 0.029$
- $p(z_{1,2} = 2) = \left(\frac{0+1.000}{2+3.000}\right) \times \left(\frac{0+1.000}{5+5.000}\right) = 0.200 \times 0.100 = 0.020 = 0.020$

New assignment for (1, 2): 0

Sampling Token H

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

Sampling Token H

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,0} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$

Sampling Token H

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,0} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,0} = 1) = \left(\frac{2+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.500 \times 0.286 = 0.143 = 0.143$

Sampling Token H

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,0} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,0} = 1) = \left(\frac{2+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.500 \times 0.286 = 0.143 = 0.143$
- $p(z_{2,0} = 2) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{5+5.000}\right) = 0.333 \times 0.200 = 0.067 = 0.067$

Sampling Token H

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,0} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,0} = 1) = \left(\frac{2+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.500 \times 0.286 = 0.143 = 0.143$
- $p(z_{2,0} = 2) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{5+5.000}\right) = 0.333 \times 0.200 = 0.067 = 0.067$

Sampling Token H

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 0, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog iron
Topic 1 :pig iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,0} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,0} = 1) = \left(\frac{2+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{2+5.000}\right) = 0.500 \times 0.286 = 0.143 = 0.143$
- $p(z_{2,0} = 2) = \left(\frac{1+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{5+5.000}\right) = 0.333 \times 0.200 = 0.067 = 0.067$

New assignment for (2, 0): 1

Sampling Token I

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron
Topic 2 :pig dog iron cat cat

Sampling Token I

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,1} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$

Sampling Token I

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,1} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,1} = 1) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{2+1.000}{3+5.000}\right) = 0.667 \times 0.375 = 0.250 = 0.250$

Sampling Token I

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,1} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,1} = 1) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{2+1.000}{3+5.000}\right) = 0.667 \times 0.375 = 0.250 = 0.250$
- $p(z_{2,1} = 2) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{4+5.000}\right) = 0.167 \times 0.111 = 0.019 = 0.019$

Sampling Token I

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,1} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,1} = 1) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{2+1.000}{3+5.000}\right) = 0.667 \times 0.375 = 0.250 = 0.250$
- $p(z_{2,1} = 2) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{4+5.000}\right) = 0.167 \times 0.111 = 0.019 = 0.019$

Sampling Token I

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 2, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron
Topic 2 :pig dog iron cat cat

- $p(z_{2,1} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,1} = 1) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{2+1.000}{3+5.000}\right) = 0.667 \times 0.375 = 0.250 = 0.250$
- $p(z_{2,1} = 2) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{4+5.000}\right) = 0.167 \times 0.111 = 0.019 = 0.019$

New assignment for (2, 1): 1

Sampling Token J

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 1, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron iron
Topic 2 :pig dog cat cat

Sampling Token J

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 1, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron iron
Topic 2 :pig dog cat cat

- $p(z_{2,2} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$

Sampling Token J

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 1, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron iron
Topic 2 :pig dog cat cat

- $p(z_{2,2} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,2} = 1) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.667 \times 0.125 = 0.083 = 0.083$

Sampling Token J

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 1, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron iron
Topic 2 :pig dog cat cat

- $p(z_{2,2} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,2} = 1) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.667 \times 0.125 = 0.083 = 0.083$
- $p(z_{2,2} = 2) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{1+1.000}{4+5.000}\right) = 0.167 \times 0.222 = 0.037 = 0.037$

Sampling Token J

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
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Topics

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New assignment for (2, 2): 1

Sampling Token K

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 1, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
Topic 1 :pig iron iron iron
Topic 2 :pig dog cat cat

Sampling Token K

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
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Topics

Topic 0 :hamburger hamburger dog
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Topic 2 :pig dog cat cat

- $p(z_{2,3} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$

Sampling Token K

Assignments

$\text{Doc}_0 : z_A = 2, z_B = 2, z_C = 2, z_D = 2$
$\text{Doc}_1 : z_E = 0, z_F = 0, z_G = 0$
$\text{Doc}_2 : z_H = 1, z_I = 1, z_J = 1, z_K = 1$

Topics

Topic 0 :hamburger hamburger dog
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Topic 2 :pig dog cat cat

- $p(z_{2,3} = 0) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{3+5.000}\right) = 0.167 \times 0.125 = 0.021 = 0.021$
- $p(z_{2,3} = 1) = \left(\frac{3+1.000}{3+3.000}\right) \times \left(\frac{2+1.000}{3+5.000}\right) = 0.667 \times 0.375 = 0.250 = 0.250$

Sampling Token K

Assignments

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- $p(z_{2,3} = 2) = \left(\frac{0+1.000}{3+3.000}\right) \times \left(\frac{0+1.000}{4+5.000}\right) = 0.167 \times 0.111 = 0.019 = 0.019$

Sampling Token K

Assignments

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New assignment for (2, 3): 1