Hello World

long subtitle

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A sample slide

a hyperlink
A displayed formula:

$$\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}$$

An itemized list:

- itemized item 1, hahaha
- itemized item 2

1. The first item
2. The second item

Theorem

1.1 In a right triangle, the square of hypotenuse equals the sum of squares of two other sides.

123

hello

First Item Description of first item

Second Item Description of second item

First column text and/or code

Second column text and/or code

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a table

Matrix	`randQB_EI`(Alg. 2)		`svds`		Adaptive PCA Framework			
	time (s)	k	time (s)	k^*	time (s)	k	Sp1	Sp2
MovieLens-1M	3.83	118	3.0	117	**1.75**	118	1.8	1.7
hetrec2011	40.3	328	71.8	325	**29.1**	327	1.4	2.5
BookCrossing	2739	3012	6758	3004	**1004**	3014	**2.8**	**6.7**
MovieLens-20M	1476	883	3722	879	**704**	883	2.1	5.3

Figure: Caption here

a code

```
def create_costco(shape, rank, nc):
    inputs = [keras.Input(shape=(1,), dtype="int32") for i in range(len(shape))]
    embeds = [
        keras.layers.Embedding(output_dim=rank, input_dim=shape[i])(inputs[i])
        for i in range(len(shape))]
    x = keras.layers.Concatenate(axis=1)(embeds)
    x = keras.layers.Reshape(target_shape=(rank, len(shape), 1))(x)
    x = keras.layers.Flatten()(x)
    x = keras.layers.Dense(nc, activation="relu")(x)
    outputs = keras.layers.Dense(1, activation="relu")(x)
    model = keras.Model(inputs=inputs, outputs=outputs)
    return model
```

an algorithm

Require: $\mathbf{A} \in \mathbb{R}^{m\times n}$ $(m \le n)$, block size b, pass parameter $q > 2$

Ensure: $\mathbf{U} \in \mathbb{R}^{m\times k}$, $\mathbf{S} \in \mathbb{R}^{k}$, $\mathbf{V} \in \mathbb{R}^{k\times n}$ for certain accuracy criterion

$\mathbf{Q} = [\,], \quad \mathbf{B} = [\,]$
for $l = 1, 2, 3, \cdots,$ **do**
  if q is an even number
    $\mathbf{\Omega} = \text{randn}(n, b), \mathbf{Y} = \mathbf{A\Omega} - \mathbf{Q}(\mathbf{B\Omega})$
    $[\mathbf{Q}_l, \sim] = \text{lu}(\mathbf{Y})$ # LU factorization replaces QR factorization
  else
    $\mathbf{Q}_l = \text{randn}(m, b)$ # when q is an odd number
  for $t = 1, 2, \cdots, \lfloor \frac{q-1}{2} \rfloor$ **do**
    if $t == \lfloor \frac{q-1}{2} \rfloor$
      $\mathbf{R} = \mathbf{A}^{\mathrm{T}}\mathbf{Q}_l$ # remove one orthogonalization
      $\mathbf{Q}_l = \mathrm{orth}(\mathbf{AR} - \mathbf{Q}(\mathbf{BR}))$ # the last one in power iteration
    else
      $[\mathbf{Q}_l, \sim] = \text{lu}(\mathbf{A}(\mathbf{A}^{\mathrm{T}}\mathbf{Q}_l))$ # LU factorization replaces QR factorization
  end for
  $\mathbf{Q}_l = \mathrm{orth}(\mathbf{Q}_l - \mathbf{Q}(\mathbf{Q}^{\mathrm{T}}\mathbf{Q}_l)), \mathbf{B}_l = \mathbf{Q}_l^{\mathrm{T}}\mathbf{A}$
  $\mathbf{Q} = \begin{bmatrix}\mathbf{Q} & \mathbf{Q}_l\end{bmatrix}, \ \mathbf{B} = \begin{bmatrix}\mathbf{B} \\ \mathbf{B}_l\end{bmatrix}$
  if termination criterion is met
    k is determined and then break
end for
$[\widehat{\mathbf{U}}, \widehat{\mathbf{S}}, \widehat{\mathbf{V}}] = \mathrm{eigSVD}(\mathbf{B}^{\mathrm{T}})$ # use eigen-decomposition to compute SVD
$ind = lb : -1 : lb - k + 1$
$\mathbf{U} = \mathbf{Q}\widehat{\mathbf{V}}(:, ind), \ \mathbf{S} = \widehat{\mathbf{S}}(ind), \ \mathbf{V} = \widehat{\mathbf{U}}(:, ind)$

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hihi

- First point, shown on all slides.

hihi

- First point, shown on all slides.
- Second point, shown on slide 2 and later.

hihi

- First point, shown on all slides.
- Second point, shown on slide 2 and later.
- Third point, also shown on slide 2 and later.

hihi

- First point, shown on all slides.
- Second point, shown on slide 2 and later.
- Third point, also shown on slide 2 and later.
- Fourth point, shown on slide 3.

Questions?