Principal Component Analysis

Quiz, 5 questions

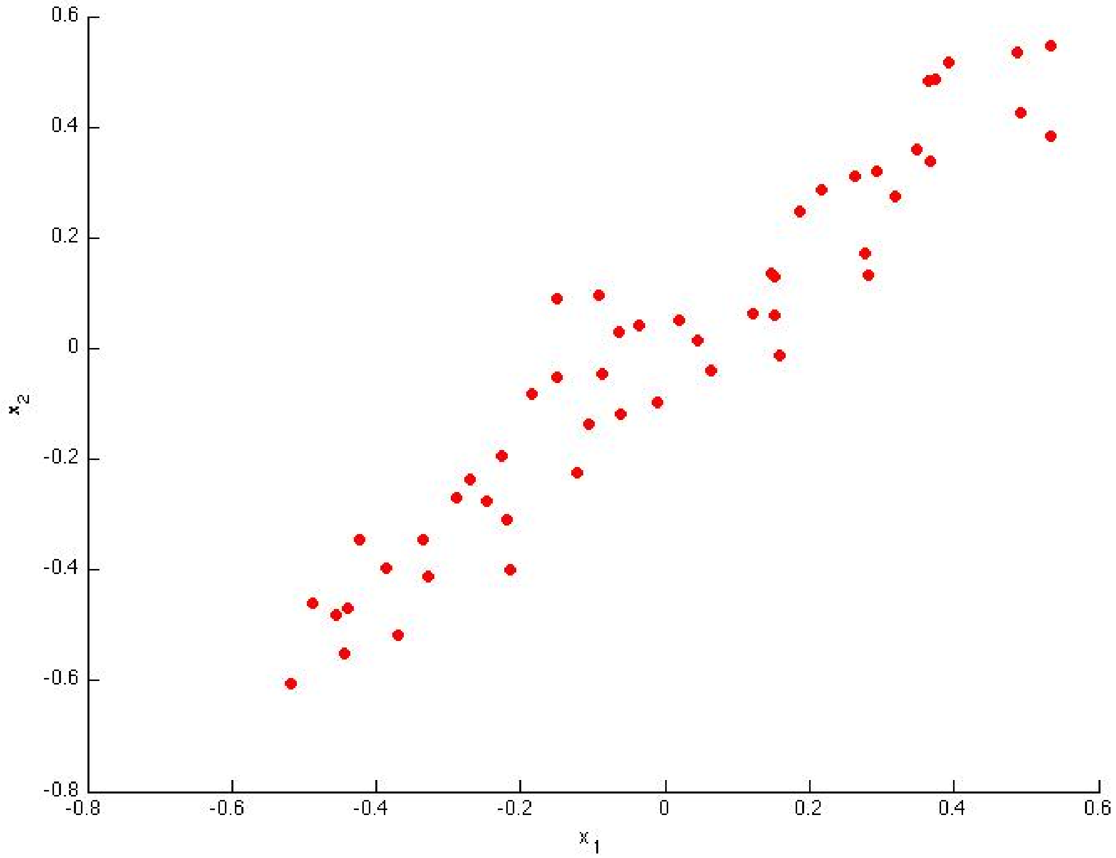
4/5 points (80%)

Congratulations! You passed!

Next Item

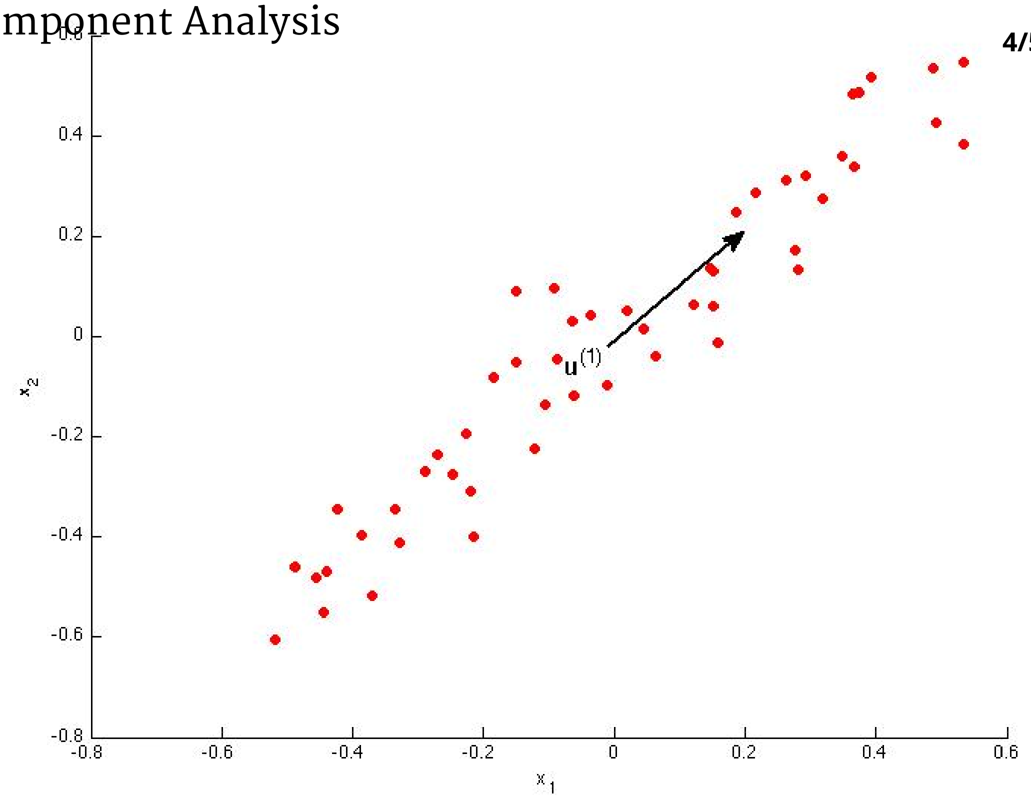
1 / 1
point

1.
Consider the following 2D dataset:



Which of the following figures correspond to possible values that PCA may return for $u^{(1)}$ (the first eigenvector / first principal component)? Check all that apply (you may have to check more than one figure).

☐



Correct

The maximal variance is along the y = x line, so this option is correct.

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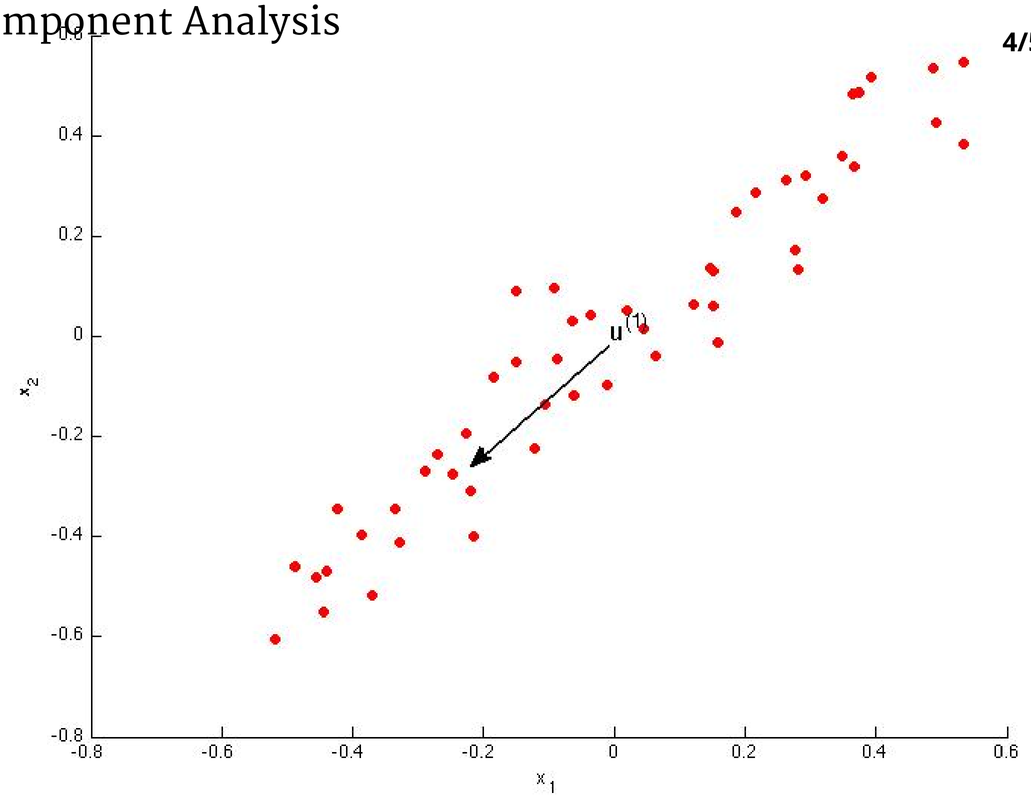
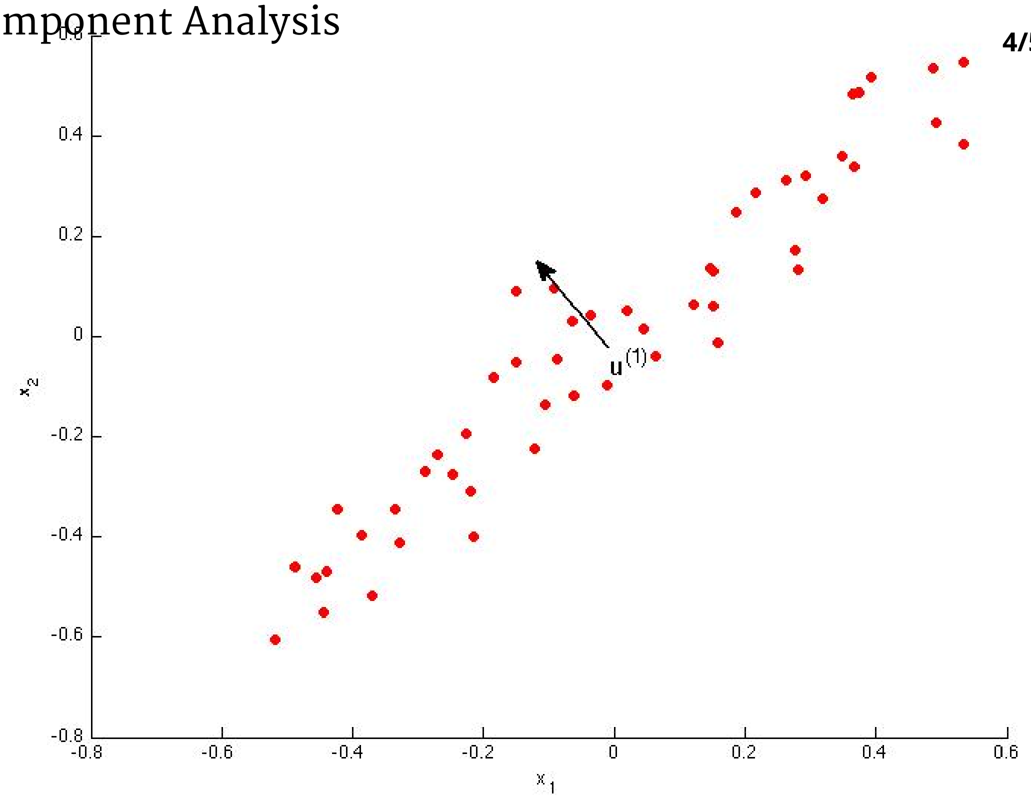
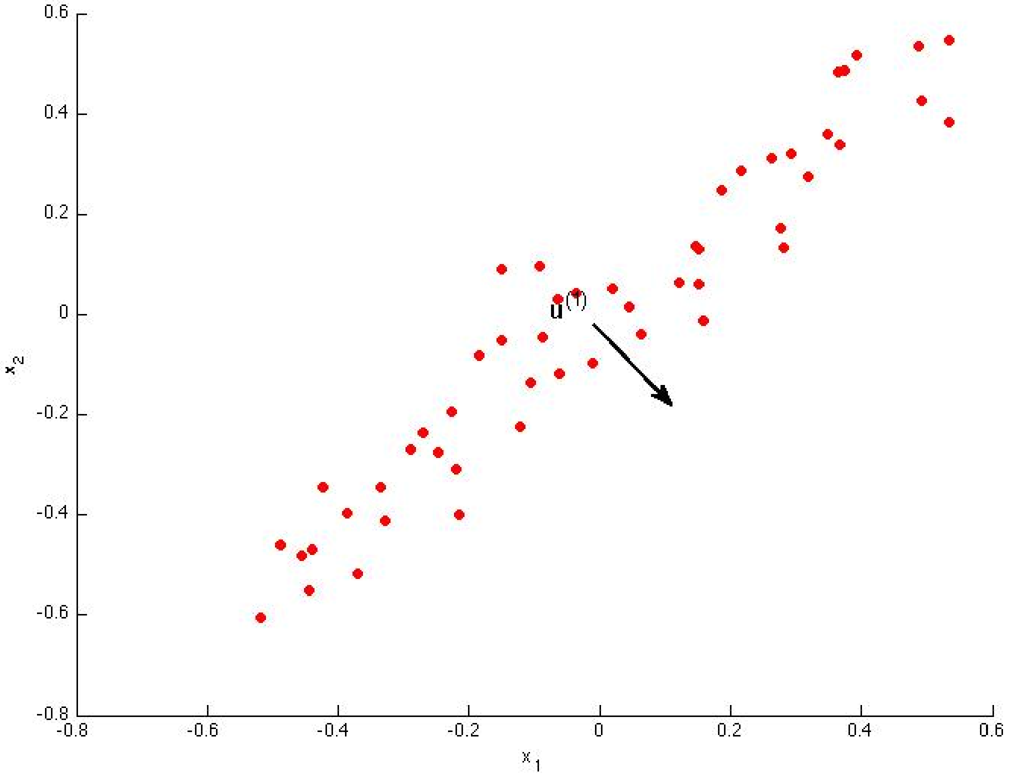


Correct

The maximal variance is along the y = x line, so the negative vector along that line is correct for the first principal component.



Un-selected is correct



Un-selected is correct

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point

2.
Which of the following is a reasonable way to select the number of principal components k?

(Recall that n is the dimensionality of the input data and m is the number of input examples.)

- Choose the value of k that minimizes the approximation error $\frac{1}{m}\sum_{i=1}^{m}||x^{(i)} - x_{\text{approx}}^{(i)}||^2$.
- Choose k to be the smallest value so that at least 1% of the variance is retained.
- Choose k to be the smallest value so that at least 99% of the variance is retained.

Correct
This is correct, as it maintains the structure of the data while maximally reducing its dimension.

- Choose k to be 99% of n (i.e., $k = 0.99 * n$, rounded to the nearest integer).

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1 / 1
point

3.
Suppose someone tells you that they ran PCA in such a way that "95% of the variance was retained." What is an equivalent statement to this?

- $\frac{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)}||^2}{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)} - x_{\text{approx}}^{(i)}||^2} \leq 0.05$
- $\frac{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)}||^2}{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)} - x_{\text{approx}}^{(i)}||^2} \leq 0.95$
- $\frac{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)} - x_{\text{approx}}^{(i)}||^2}{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)}||^2} \leq 0.05$

Correct
This is the correct formula.

- $\frac{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)}||^2}{\frac{1}{m}\sum_{i=1}^{m}||x^{(i)} - x_{\text{approx}}^{(i)}||^2} \geq 0.05$

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4.

Which of the following statements are true? Check all that apply.

- [ ] PCA is susceptible to local optima; trying multiple random initializations may help.

Un-selected is correct

- [ ] Given only $z^{(i)}$ and U_{reduce}, there is no way to reconstruct any reasonable approximation to $x^{(i)}$.

Un-selected is correct

- [ ] Even if all the input features are on very similar scales, we should still perform mean normalization (so that each feature has zero mean) before running PCA.

Correct

If you do not perform mean normalization, PCA will rotate the data in a possibly undesired way.

- [ ] Given input data $x \in \mathbb{R}^n$, it makes sense to run PCA only with values of k that satisfy $k \leq n$. (In particular, running it with $k = n$ is possible but not helpful, and $k > n$ does not make sense.)

This should be selected

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point

5.

Which of the following are recommended applications of PCA? Select all that apply.

- [ ] Data compression: Reduce the dimension of your input data $x^{(i)}$, which will be used in a supervised learning algorithm (i.e., use PCA so that your supervised learning algorithm runs faster).

Correct

If your learning algorithm is too slow because the input dimension is too high, then using PCA to speed it up is a reasonable choice.

- [ ] Clustering: To automatically group examples into coherent groups.

Un-selected is correct

- [ ] To get more features to feed into a learning algorithm.

Un-selected is correct

- [ ] Data visualization: Reduce data to 2D (or 3D) so that it can be plotted.

Correct
This is a good use of PCA, as it can give you intuition about your data that would otherwise be impossible to see.