

Programming Ex.2

Note for MATLAB users: If you are using MATLAB version R2015a or later, the `fminunc()` function has been changed in this version. The function works better, but does not give the expected result for Figure 5 in `ex2.pdf`, and it throws some warning messages (about a local minimum) when you run `ex2_reg.m`. This is normal, and you should still be able to submit your work to the grader.

Typos in the lectures (updated):

There are typos in the week 3 lectures, specifically for regularized logistic regression. This could create some confusion while doing the the last part of exercise 2. The equations in `ex2.pdf` are correct.

Gradient and theta values for ex2.m

Here are the values of both `cost J` and the gradients for the "initial theta (zeros)" test (`ex2.pdf` Section 1.2.2):

```
1 Cost at initial theta (zeros): 0.693147
2 Gradient at initial theta (zeros):
3 -0.100000
4 -12.009217
5 -11.262842
6 |
```

Here are the values for both `cost J` and theta for the "theta found by `fminunc`" test (`ex2.pdf` Section 1.2.3):

```
1 Cost at theta found by fminunc: 0.203498
2 theta:
3 -25.164593
4 0.206261
5 0.201499
6 |
```

mapFeature() discussion:

For two features x_1 and x_2 , `mapFeature` calculates following terms.

$1, x_1, x_2, x_1x_2, x_2^2, x_1^2x_2, x_1x_2^2, x_2^3, x_1^3, x_1^2x_2^2, x_1x_2^3, x_2^4, x_1^4, x_1^3x_2, x_1^2x_2^2, x_1x_2^3, x_2^5, x_1^5, x_1^4x_2, x_1^3x_2^2, x_1^2x_2^3, x_1x_2^4, x_2^6, x_1^6, x_1^5x_2, x_1^4x_2^2, x_1^3x_2^3, x_1^2x_2^4, x_1x_2^5, x_2^7, x_1^7, x_1^6x_2, x_1^5x_2^2, x_1^4x_2^3, x_1^3x_2^4, x_1^2x_2^5, x_1x_2^6, x_2^8, x_1^8, x_1^7x_2, x_1^6x_2^2, x_1^5x_2^3, x_1^4x_2^4, x_1^3x_2^5, x_1^2x_2^6, x_1x_2^7, x_2^9, x_1^9, x_1^8x_2, x_1^7x_2^2, x_1^6x_2^3, x_1^5x_2^4, x_1^4x_2^5, x_1^3x_2^6, x_1^2x_2^7, x_1x_2^8, x_2^{10}, x_1^{10}, x_1^9x_2, x_1^8x_2^2, x_1^7x_2^3, x_1^6x_2^4, x_1^5x_2^5, x_1^4x_2^6, x_1^3x_2^7, x_1^2x_2^8, x_1x_2^9, x_2^{11}, x_1^{11}, x_1^{10}x_2, x_1^9x_2^2, x_1^8x_2^3, x_1^7x_2^4, x_1^6x_2^5, x_1^5x_2^6, x_1^4x_2^7, x_1^3x_2^8, x_1^2x_2^9, x_1x_2^{10}, x_2^{12}, x_1^{12}, x_1^{11}x_2, x_1^{10}x_2^2, x_1^9x_2^3, x_1^8x_2^4, x_1^7x_2^5, x_1^6x_2^6, x_1^5x_2^7, x_1^4x_2^8, x_1^3x_2^9, x_1^2x_2^{10}, x_1x_2^{11}, x_2^{13}, x_1^{13}, x_1^{12}x_2, x_1^{11}x_2^2, x_1^{10}x_2^3, x_1^9x_2^4, x_1^8x_2^5, x_1^7x_2^6, x_1^6x_2^7, x_1^5x_2^8, x_1^4x_2^9, x_1^3x_2^{10}, x_1^2x_2^{11}, x_1x_2^{12}, x_2^{14}, x_1^{14}, x_1^{13}x_2, x_1^{12}x_2^2, x_1^{11}x_2^3, x_1^{10}x_2^4, x_1^9x_2^5, x_1^8x_2^6, x_1^7x_2^7, x_1^6x_2^8, x_1^5x_2^9, x_1^4x_2^{10}, x_1^3x_2^{11}, x_1^2x_2^{12}, x_1x_2^{13}, x_2^{15}, x_1^{15}, x_1^{14}x_2, x_1^{13}x_2^2, x_1^{12}x_2^3, x_1^{11}x_2^4, x_1^{10}x_2^5, x_1^9x_2^6, x_1^8x_2^7, x_1^7x_2^8, x_1^6x_2^9, x_1^5x_2^{10}, x_1^4x_2^{11}, x_1^3x_2^{12}, x_1^2x_2^{13}, x_1x_2^{14}, x_2^{16}, x_1^{16}, x_1^{15}x_2, x_1^{14}x_2^2, x_1^{13}x_2^3, x_1^{12}x_2^4, x_1^{11}x_2^5, x_1^{10}x_2^6, x_1^9x_2^7, x_1^8x_2^8, x_1^7x_2^9, x_1^6x_2^{10}, x_1^5x_2^{11}, x_1^4x_2^{12}, x_1^3x_2^{13}, x_1^2x_2^{14}, x_1x_2^{15}, x_2^{17}, x_1^{17}, x_1^{16}x_2, x_1^{15}x_2^2, x_1^{14}x_2^3, x_1^{13}x_2^4, x_1^{12}x_2^5, x_1^{11}x_2^6, x_1^{10}x_2^7, x_1^9x_2^8, x_1^8x_2^9, x_1^7x_2^{10}, x_1^6x_2^{11}, x_1^5x_2^{12}, x_1^4x_2^{13}, x_1^3x_2^{14}, x_1^2x_2^{15}, x_1x_2^{16}, x_2^{18}, x_1^{18}, x_1^{17}x_2, x_1^{16}x_2^2, x_1^{15}x_2^3, x_1^{14}x_2^4, x_1^{13}x_2^5, x_1^{12}x_2^6, x_1^{11}x_2^7, x_1^{10}x_2^8, x_1^9x_2^9, x_1^8x_2^{10}, x_1^7x_2^{11}, x_1^6x_2^{12}, x_1^5x_2^{13}, x_1^4x_2^{14}, x_1^3x_2^{15}, x_1^2x_2^{16}, x_1x_2^{17}, x_2^{19}, x_1^{19}, x_1^{18}x_2, x_1^{17}x_2^2, x_1^{16}x_2^3, x_1^{15}x_2^4, x_1^{14}x_2^5, x_1^{13}x_2^6, x_1^{12}x_2^7, x_1^{11}x_2^8, x_1^{10}x_2^9, x_1^9x_2^{10}, x_1^8x_2^{11}, x_1^7x_2^{12}, x_1^6x_2^{13}, x_1^5x_2^{14}, x_1^4x_2^{15}, x_1^3x_2^{16}, x_1^2x_2^{17}, x_1x_2^{18}, x_2^{20}, x_1^{20}, x_1^{19}x_2, x_1^{18}x_2^2, x_1^{17}x_2^3, x_1^{16}x_2^4, x_1^{15}x_2^5, x_1^{14}x_2^6, x_1^{13}x_2^7, x_1^{12}x_2^8, x_1^{11}x_2^9, x_1^{10}x_2^{10}, x_1^9x_2^{11}, x_1^8x_2^{12}, x_1^7x_2^{13}, x_1^6x_2^{14}, x_1^5x_2^{15}, x_1^4x_2^{16}, x_1^3x_2^{17}, x_1^2x_2^{18}, x_1x_2^{19}, x_2^{21}, x_1^{21}, x_1^{20}x_2, x_1^{19}x_2^2, x_1^{18}x_2^3, x_1^{17}x_2^4, x_1^{16}x_2^5, x_1^{15}x_2^6, x_1^{14}x_2^7, x_1^{13}x_2^8, x_1^{12}x_2^9, x_1^{11}x_2^{10}, x_1^{10}x_2^{11}, x_1^9x_2^{12}, x_1^8x_2^{13}, x_1^7x_2^{14}, x_1^6x_2^{15}, x_1^5x_2^{16}, x_1^4x_2^{17}, x_1^3x_2^{18}, x_1^2x_2^{19}, x_1x_2^{20}, x_2^{22}, x_1^{22}, x_1^{21}x_2, x_1^{20}x_2^2, x_1^{19}x_2^3, x_1^{18}x_2^4, x_1^{17}x_2^5, x_1^{16}x_2^6, x_1^{15}x_2^7, x_1^{14}x_2^8, x_1^{13}x_2^9, x_1^{12}x_2^{10}, x_1^{11}x_2^{11}, x_1^{10}x_2^{12}, x_1^9x_2^{13}, x_1^8x_2^{14}, x_1^7x_2^{15}, x_1^6x_2^{16}, x_1^5x_2^{17}, x_1^4x_2^{18}, x_1^3x_2^{19}, x_1^2x_2^{20}, x_1x_2^{21}, x_2^{23}, x_1^{23}, x_1^{22}x_2, x_1^{21}x_2^2, x_1^{20}x_2^3, x_1^{19}x_2^4, x_1^{18}x_2^5, x_1^{17}x_2^6, x_1^{16}x_2^7, x_1^{15}x_2^8, x_1^{14}x_2^9, x_1^{13}x_2^{10}, x_1^{12}x_2^{11}, x_1^{11}x_2^{12}, x_1^{10}x_2^{13}, x_1^9x_2^{14}, x_1^8x_2^{15}, x_1^7x_2^{16}, x_1^6x_2^{17}, x_1^5x_2^{18}, x_1^4x_2^{19}, x_1^3x_2^{20}, x_1^2x_2^{21}, x_1x_2^{22}, x_2^{24}, x_1^{24}, x_1^{23}x_2, x_1^{22}x_2^2, x_1^{21}x_2^3, x_1^{20}x_2^4, x_1^{19}x_2^5, x_1^{18}x_2^6, x_1^{17}x_2^7, x_1^{16}x_2^8, x_1^{15}x_2^9, x_1^{14}x_2^{10}, x_1^{13}x_2^{11}, x_1^{12}x_2^{12}, x_1^{11}x_2^{13}, x_1^{10}x_2^{14}, x_1^9x_2^{15}, x_1^8x_2^{16}, x_1^7x_2^{17}, x_1^6x_2^{18}, x_1^5x_2^{19}, x_1^4x_2^{20}, x_1^3x_2^{21}, x_1^2x_2^{22}, x_1x_2^{23}, x_2^{25}, x_1^{25}, x_1^{24}x_2, x_1^{23}x_2^2, x_1^{22}x_2^3, x_1^{21}x_2^4, x_1^{20}x_2^5, x_1^{19}x_2^6, x_1^{18}x_2^7, x_1^{17}x_2^8, x_1^{16}x_2^9, x_1^{15}x_2^{10}, x_1^{14}x_2^{11}, x_1^{13}x_2^{12}, x_1^{12}x_2^{13}, x_1^{11}x_2^{14}, x_1^{10}x_2^{15}, x_1^9x_2^{16}, x_1^8x_2^{17}, x_1^7x_2^{18}, x_1^6x_2^{19}, x_1^5x_2^{20}, x_1^4x_2^{21}, x_1^3x_2^{22}, x_1^2x_2^{23}, x_1x_2^{24}, x_2^{26}, x_1^{26}, x_1^{25}x_2, x_1^{24}x_2^2, x_1^{23}x_2^3, x_1^{22}x_2^4, x_1^{21}x_2^5, x_1^{20}x_2^6, x_1^{19}x_2^7, x_1^{18}x_2^8, x_1^{17}x_2^9, x_1^{16}x_2^{10}, x_1^{15}x_2^{11}, x_1^{14}x_2^{12}, x_1^{13}x_2^{13}, x_1^{12}x_2^{14}, x_1^{11}x_2^{15}, x_1^{10}x_2^{16}, x_1^9x_2^{17}, x_1^8x_2^{18}, x_1^7x_2^{19}, x_1^6x_2^{20}, x_1^5x_2^{21}, x_1^4x_2^{22}, x_1^3x_2^{23}, x_1^2x_2^{24}, x_1x_2^{25}, x_2^{27}, x_1^{27}, x_1^{26}x_2, x_1^{25}x_2^2, x_1^{24}x_2^3, x_1^{23}x_2^4, x_1^{22}x_2^5, x_1^{21}x_2^6, x_1^{20}x_2^7, x_1^{19}x_2^8, x_1^{18}x_2^9, x_1^{17}x_2^{10}, x_1^{16}x_2^{11}, x_1^{15}x_2^{12}, x_1^{14}x_2^{13}, x_1^{13}x_2^{14}, x_1^{12}x_2^{15}, x_1^{11}x_2^{16}, x_1^{10}x_2^{17}, x_1^9x_2^{18}, x_1^8x_2^{19}, x_1^7x_2^{20}, x_1^6x_2^{21}, x_1^5x_2^{22}, x_1^4x_2^{23}, x_1^3x_2^{24}, x_1^2x_2^{25}, x_1x_2^{26}, x_2^{28}, x_1^{28}, x_1^{27}x_2, x_1^{26}x_2^2, x_1^{25}x_2^3, x_1^{24}x_2^4, x_1^{23}x_2^5, x_1^{22}x_2^6, x_1^{21}x_2^7, x_1^{20}x_2^8, x_1^{19}x_2^9, x_1^{18}x_2^{10}, x_1^{17}x_2^{11}, x_1^{16}x_2^{12}, x_1^{15}x_2^{13}, x_1^{14}x_2^{14}, x_1^{13}x_2^{15}, x_1^{12}x_2^{16}, x_1^{11}x_2^{17}, x_1^{10}x_2^{18}, x_1^9x_2^{19}, x_1^8x_2^{20}, x_1^7x_2^{21}, x_1^6x_2^{22}, x_1^5x_2^{23}, x_1^4x_2^{24}, x_1^3x_2^{25}, x_1^2x_2^{26}, x_1x_2^{27}, x_2^{29}, x_1^{29}, x_1^{28}x_2, x_1^{27}x_2^2, x_1^{26}x_2^3, x_1^{25}x_2^4, x_1^{24}x_2^5, x_1^{23}x_2^6, x_1^{22}x_2^7, x_1^{21}x_2^8, x_1^{20}x_2^9, x_1^{19}x_2^{10}, x_1^{18}x_2^{11}, x_1^{17}x_2^{12}, x_1^{16}x_2^{13}, x_1^{15}x_2^{14}, x_1^{14}x_2^{15}, x_1^{13}x_2^{16}, x_1^{12}x_2^{17}, x_1^{11}x_2^{18}, x_1^{10}x_2^{19}, x_1^9x_2^{20}, x_1^8x_2^{21}, x_1^7x_2^{22}, x_1^6x_2^{23}, x_1^5x_2^{24}, x_1^4x_2^{25}, x_1^3x_2^{26}, x_1^2x_2^{27}, x_1x_2^{28}, x_2^{30}, x_1^{30}, x_1^{29}x_2, x_1^{28}x_2^2, x_1^{27}x_2^3, x_1^{26}x_2^4, x_1^{25}x_2^5, x_1^{24}x_2^6, x_1^{23}x_2^7, x_1^{22}x_2^8, x_1^{21}x_2^9, x_1^{20}x_2^{10}, x_1^{19}x_2^{11}, x_1^{18}x_2^{12}, x_1^{17}x_2^{13}, x_1^{16}x_2^{14}, x_1^{15}x_2^{15}, x_1^{14}x_2^{16}, x_1^{13}x_2^{17}, x_1^{12}x_2^{18}, x_1^{11}x_2^{19}, x_1^{10}x_2^{20}, x_1^9x_2^{21}, x_1^8x_2^{22}, x_1^7x_2^{23}, x_1^6x_2^{24}, x_1^5x_2^{25}, x_1^4x_2^{26}, x_1^3x_2^{27}, x_1^2x_2^{28}, x_1x_2^{29}, x_2^{31}, x_1^{31}, x_1^{30}x_2, x_1^{29}x_2^2, x_1^{28}x_2^3, x_1^{27}x_2^4, x_1^{26}x_2^5, x_1^{25}x_2^6, x_1^{24}x_2^7, x_1^{23}x_2^8, x_1^{22}x_2^9, x_1^{21}x_2^{10}, x_1^{20}x_2^{11}, x_1^{19}x_2^{12}, x_1^{18}x_2^{13}, x_1^{17}x_2^{14}, x_1^{16}x_2^{15}, x_1^{15}x_2^{16}, x_1^{14}x_2^{17}, x_1^{13}x_2^{18}, x_1^{12}x_2^{19}, x_1^{11}x_2^{20}, x_1^{10}x_2^{21}, x_1^9x_2^{22}, x_1^8x_2^{23}, x_1^7x_2^{24}, x_1^6x_2^{25}, x_1^5x_2^{26}, x_1^4x_2^{27}, x_1^3x_2^{28}, x_1^2x_2^{29}, x_1x_2^{30}, x_2^{32}, x_1^{32}, x_1^{31}x_2, x_1^{30}x_2^2, x_1^{29}x_2^3, x_1^{28}x_2^4, x_1^{27}x_2^5, x_1^{26}x_2^6, x_1^{25}x_2^7, x_1^{24}x_2^8, x_1^{23}x_2^9, x_1^{22}x_2^{10}, x_1^{21}x_2^{11}, x_1^{20}x_2^{12}, x_1^{19}x_2^{13}, x_1^{18}x_2^{14}, x_1^{17}x_2^{15}, x_1^{16}x_2^{16}, x_1^{15}x_2^{17}, x_1^{14}x_2^{18}, x_1^{13}x_2^{19}, x_1^{12}x_2^{20}, x_1^{11}x_2^{21}, x_1^{10}x_2^{22}, x_1^9x_2^{23}, x_1^8x_2^{24}, x_1^7x_2^{25}, x_1^6x_2^{26}, x_1^5x_2^{27}, x_1^4x_2^{28}, x_1^3x_2^{29}, x_1^2x_2^{30}, x_1x_2^{31}, x_2^{33}, x_1^{33}, x_1^{32}x_2, x_1^{31}x_2^2, x_1^{30}x_2^3, x_1^{29}x_2^4, x_1^{28}x_2^5, x_1^{27}x_2^6, x_1^{26}x_2^7, x_1^{25}x_2^8, x_1^{24}x_2^9, x_1^{23}x_2^{10}, x_1^{22}x_2^{11}, x_1^{21}x_2^{12}, x_1^{20}x_2^{13}, x_1^{19}x_2^{14}, x_1^{18}x_2^{15}, x_1^{17}x_2^{16}, x_1^{16}x_2^{17}, x_1^{15}x_2^{18}, x_1^{14}x_2^{19}, x_1^{13}x_2^{20}, x_1^{12}x_2^{21}, x_1^{11}x_2^{22}, x_1^{10}x_2^{23}, x_1^9x_2^{24}, x_1^8x_2^{25}, x_1^7x_2^{26}, x_1^6x_2^{27}, x_1^5x_2^{28}, x_1^4x_2^{29}, x_1^3x_2^{30}, x_1^2x_2^{31}, x_1x_2^{32}, x_2^{34}, x_1^{34}, x_1^{33}x_2, x_1^{32}x_2^2, x_1^{31}x_2^3, x_1^{30}x_2^4, x_1^{29}x_2^5, x_1^{28}x_2^6, x_1^{27}x_2^7, x_1^{26}x_2^8, x_1^{25}x_2^9, x_1^{24}x_2^{10}, x_1^{23}x_2^{11}, x_1^{22}x_2^{12}, x_1^{21}x_2^{13}, x_1^{20}x_2^{14}, x_1^{19}x_2^{15}, x_1^{18}x_2^{16}, x_1^{17}x_2^{17}, x_1^{16}x_2^{18}, x_1^{15}x_2^{19}, x_1^{14}x_2^{20}, x_1^{13}x_2^{21}, x_1^{12}x_2^{22}, x_1^{11}x_2^{23}, x_1^{10}x_2^{24}, x_1^9x_2^{25}, x_1^8x_2^{26}, x_1^7x_2^{27}, x_1^6x_2^{28}, x_1^5x_2^{29}, x_1^4x_2^{30}, x_1^3x_2^{31}, x_1^2x_2^{32}, x_1x_2^{33}, x_2^{35}, x_1^{35}, x_1^{34}x_2, x_1^{33}x_2^2, x_1^{32}x_2^3, x_1^{31}x_2^4, x_1^{30}x_2^5, x_1^{29}x_2^6, x_1^{28}x_2^7, x_1^{27}x_2^8, x_1^{26}x_2^9, x_1^{25}x_2^{10}, x_1^{24}x_2^{11}, x_1^{23}x_2^{12}, x_1^{22}x_2^{13}, x_1^{21}x_2^{14}, x_1^{20}x_2^{15}, x_1^{19}x_2^{16}, x_1^{18}x_2^{17}, x_1^{17}x_2^{18}, x_1^{16}x_2^{19}, x_1^{15}x_2^{20}, x_1^{14}x_2^{21}, x_1^{13}x_2^{22}, x_1^{12}x_2^{23}, x_1^{11}x_2^{24}, x_1^{10}x_2^{25}, x_1^9x_2^{26}, x_1^8x_2^{27}, x_1^7x_2^{28}, x_1^6x_2^{29}, x_1^5x_2^{30}, x_1^4x_2^{31}, x_1^3x_2^{32}, x_1^2x_2^{33}, x_1x_2^{34}, x_2^{36}, x_1^{36}, x_1^{35}x_2, x_1^{34}x_2^2, x_1^{33}x_2^3, x_1^{32}x_2^4, x_1^{31}x_2^5, x_1^{30}x_2^6, x_1^{29}x_2^7, x_1^{28}x_2^8, x_1^{27}x_2^9, x_1^{26}x_2^{10}, x_1^{25}x_2^{11}, x_1^{24}x_2^{12}, x_1^{23}x_2^{13}, x_1^{22}x_2^{14}, x_1^{21}x_2^{15}, x_1^{20}x_2^{16}, x_1^{19}x_2^{17}, x_1^{18}x_2^{18}, x_1^{17}x_2^{19}, x_1^{16}x_2^{20}, x_1^{15}x_2^{21}, x_1^{14}x_2^{22}, x_1^{13}x_2^{23}, x_1^{12}x_2^{24}, x_1^{11}x_2^{25}, x_1^{10}x_2^{26}, x_1^9x_2^{27}, x_1^8x_2^{28}, x_1^7x_2^{29}, x_1^6x_2^{30}, x_1^5x_2^{31}, x_1^4x_2^{32}, x_1^3x_2^{33}, x_1^2x_2^{34}, x_1x_2^{35}, x_2^{37}, x_1^{37}, x_1^{36}x_2, x_1^{35}x_2^2, x_1^{34}x_2^3, x_1^{33}x_2^4, x_1^{32}x_2^5, x_1^{31}x_2^6, x_1^{30}x_2^7, x_1^{29}x_2^8, x_1^{28}x_2^9, x_1^{27}x_2^{10}, x_1^{26}x_2^{11}, x_1^{25}x_2^{12}, x_1^{24}x_2^{13}, x_1^{23}x_2^{14}, x_1^{22}x_2^{15}, x_1^{21}x_2^{16}, x_1^{20}x_2^{17}, x_1^{19}x_2^{18}, x_1^{18}x_2^{19}, x_1^{17}x_2^{20}, x_1^{16}x_2^{21}, x_1^{15}x_2^{22}, x_1^{14}x_2^{23}, x_1^{13}x_2^{24}, x_1^{12}x_2^{25}, x_1^{11}x_2^{26}, x_1^{10}x_2^{27}, x_1^9x_2^{28}, x_1^8x_2^{29}, x_1^7x_2^{30}, x_1^6x_2^{31}, x_1^5x_2^{32}, x_1^4x_2^{33}, x_1^3x_2^{34}, x_1^2x_2^{35}, x_1x_2^{36}, x_2^{38}, x_1^{38}, x_1^{37}x_2, x_1^{36}x_2^2, x_1^{35}x_2^3, x_1^{34}x_2^4, x_1^{33}x_2^5, x_1^{32}x_2^6, x_1^{31}x_2^7, x_1^{30}x_2^8, x_1^{29}x_2^9, x_1^{28}x_2^{10}, x_1^{27}x_2^{11}, x_1^{26}x_2^{12}, x_1^{25}x_2^{13}, x_1^{24}x_2^{14}, x_1^{23}x_2^{15}, x_1^{22}x_2^{16}, x_1^{21}x_2^{17}, x_1^{20}x_2^{18}, x_1^{19}x_2^{19}, x_1^{18}x_2^{20}, x_1^{17}x_2^{21}, x_1^{16}x_2^{22}, x_1^{15}x_2^{23}, x_1^{14}x_2^{24}, x_1^{13}x_2^{25}, x_1^{12}x_2^{26}, x_1^{11}x_2^{27}, x_1^{10}x_2^{28}, x_1^9x_2^{29}, x_1^8x_2^{30}, x_1^7x_2^{31}, x_1^6x_2^{32}, x_1^5x_2^{33}, x_1^4x_2^{34}, x_1^3x_2^{35}, x_1^2x_2^{36}, x_1x_2^{37}, x_2^{39}, x_1^{39}, x_1^{38}x_2, x_1^{37}x_2^2, x_1^{36}x_2^3, x_1^{35}x_2^4, x_1^{34}x_2^5, x_1^{33}x_2^6, x_1^{32}x_2^7, x_1^{31}x_2^8, x_1^{30}x_2^9, x_1^{29}x_2^{10}, x_1^{28}x_2^{11}, x_1^{27}x_2^{12}, x_1^{26}x_2^{13}, x_1^{25}x_2^{14}, x_1^{24}x_2^{15}, x_1^{23}x_2^{16}, x_1^{22}x_2^{17}, x_1^{21}x_2^{18}, x_1^{20}x_2^{19}, x_1^{19}x_2^{20}, x_1^{18}x_2^{21}, x_1^{17}x_2^{22}, x_1^{16}x_2^{23}, x_1^{15}x_2^{24}, x_1^{14}x_2^{25}, x_1^{13}x_2^{26}, x_1^{12}x_2^{27}, x_1^{11}x_2^{28}, x_1^{10}x_2^{29}, x_1^9x_2^{30}, x_1^8x_2^{31}, x_1^7x_2^{32}, x_1^6x_2^{33}, x_1^5x_2^{34}, x_1^4x_2^{35}, x_1^3x_2^{36}, x_1^2x_2^{37}, x_1x_2^{38}, x_2^{40}, x_1^{40}, x_1^{39}x_2, x_1^{38}x_2^2, x_1^{37}x_2^3, x_1^{36}x_2^4, x_1^{35}x_2^5, x_1^{34}x_2^6, x_1^{33}x_2^7, x_1^{32}x_2^8, x_1^{31}x_2^9, x_1^{30}x_2^{10}, x_1^{29}x_2^{11}, x_1^{28}x_2^{12}, x_1^{27}x_2^{13}, x_1^{26}x_2^{14}, x_1^{25}x_2^{15}, x_1^{24}x_2^{16}, x_1^{23}x_2^{17}, x_1^{22}x_2^{18}, x_1^{21}x_2^{19}, x_1^{20}x_2^{20}, x_1^{19}x_2^{21}, x_1^{18}x_2^{22}, x_1^{17}x_2^{23}, x_1^{16}x_2^{24}, x_1^{15}x_2^{25}, x_1^{14}x_2^{26}, x_1^{13}x_2^{27}, x_1^{12}x_2^{28}, x_1^{11}x_2^{29}, x_1^{10}x_2^{30}, x_1^9x_2^{31}, x_1^8x_2^{32}, x_1^7x_2^{33}, x_1^6x_2^{34}, x_1^5x_2^{35}, x_1^4x_2^{36}, x_1^3x_2^{37}, x_1^2x_2^{38}, x_1x_2^{39}, x_2^{41}, x_1^{41}, x_1^{40}x_2, x_1^{39}x_2^2, x_1^{38}x_2^3, x_1^{37}x_2^4, x_1^{36}x_2^5, x_1^{35}x_2^6, x_1^{34}x_2^7, x_1^{33}x_2^8, x_1^{32}x_2^9, x_1^{31}x_2^{10}, x_1^{30}x_2^{11}, x_1^{29}x_2^{12}, x_1^{28}x_2^{13}, x_1^{27}x_2^{14}, x_1^{26}x_2^{15}, x_1^{25}x_2^{16}, x_1^{24}x_2^{17}, x_1^{23}x_2^{18}, x_1^{22}x_2^{19}, x_1^{21}x_2^{20}, x_1^{20}x_2^{21}, x_1^{19}x_2^{22}, x_1^{18}x_2^{23}, x_1^{17}x_2^{24}, x_1^{16}x_2^{25}, x_1^{15}x_2^{26}, x_1^{14}x_2^{27}, x_1^{13}x_2^{28}, x_1^{12}x_2^{29}, x_1^{11}x_2^{30}, x_1^{10}x_2^{31}, x_1^9x_2^{32}, x_1^8x_2^{33}, x_1^7x_2^{34}, x_1^6x_2^{35}, x_1^5x_2^{36}, x_1^4x_2^{37}, x_1^3x_2^{38}, x_1^2x_2^{39}, x_1x_2^{40}, x_2^{42}, x_1^{42}, x_1^{41}x_2, x_1^{40}x_2^2, x_1^{39}x_2^3, x_1^{38}x_2^4, x_1^{37}x_2^5, x_1^{36}x_2^6, x_1^{35}x_2^7, x_1^{34}x_2^8, x_1^{33}x_2^9, x_1^{32}x_2^{10}, x_1^{31}x_2^{11}, x_1^{30}x_2^{12}, x_1^{29}x_2^{13}, x_1^{28}x_2^{14}, x_1^{27}x_2^{15}, x_1^{26}x_2^{16}, x_1^{25}x_2^{17}, x_1^{24}x_2^{18}, x_1^{23}x_2^{19}, x_1^{22}x_2^{20}, x_1^{21}x_2^{21}, x_1^{20}x_2^{22}, x_1^{19}x_2^{23}, x_1^{18}x_2^{24}, x_1^{17}x_2^{25}, x_1^{16}x_2^{26}, x_1^{15}x_2^{27}, x_1^{14}x_2^{28}, x_1^{13}x_2^{29}, x_1^{12}x_2^{30}, x_1^{11}x_2^{31}, x_1^{10}x_2^{32}, x_1^9x_2^{33}, x_1^8x_2^{34}, x_1^7x_2^{35}, x_1^6x_2^{36}, x_1^5x_2^{37}, x_1^4x_2^{38}, x_1^3x_2^{39}, x_1^2x_2^{40}, x_1x_2^{41}, x_2^{43}, x_1^{43}, x_1^{42}x_2, x_1^{41}x_2^2, x_1^{40}x_2^3, x_1^{39}x_2^4, x_1^{38}x_2^5, x_1^{37}x_2$

- Solve for x_3 since we're using x_2 values (the max & min values ± 2 in order to make a nice line). $\rightarrow x_3 = \frac{-1}{\theta_{\theta_3}} * (\theta_{\theta_2} x_2 + \theta_{\theta_1})$, as seen in the Octave function.
- Plug in the two x_2 values (stored in plot_x) into the above equation to get the two corresponding x_3 values (and store in the plot_y variable).
- Plot a line using these values \rightarrow this will be the decision boundary.
- Plot the rest of our data on the graph as well, and notice that the line should separate the classes.
- The above still applies even if you're using higher-order polynomial features, with the note that instead of a decision boundary "line", it will be a decision boundary "polynomial".

Lambda effect over Decision Boundary

