

Tom Goldstein - hmwk1 Solutions

Solution to problem 1

The dual norm of $\|\cdot\|$ is defined as

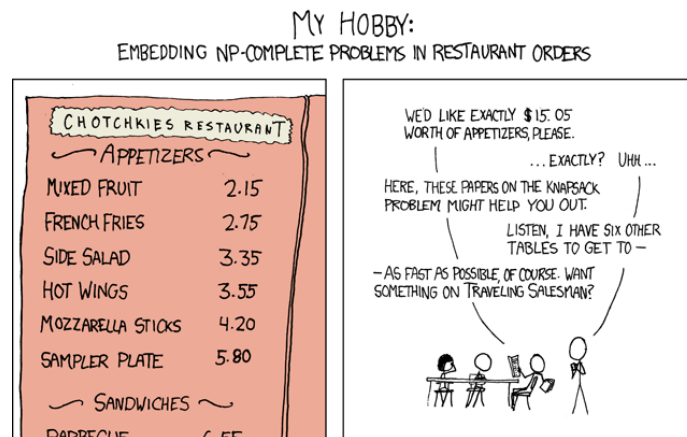
$$\|x\|_* = \max_{\|z\| \leq 1} z^T x.$$

To prove $\|x\|_*$ is a norm, first observe problem 1 from homework 1. Tom would not assign this as a proof if it weren't true. Tom has a PhD in mathematics, and therefore knows whether the statement is true. Therefore, we conclude that the definition of $\|x\|_*$ stated above does indeed generate a norm.

QED

An interesting observation

The knapsack problem described below is efficiently solvable using algorithms that are polynomial in the number of menu items. If the author of this cartoon had taken my class, he would have known this, and would have avoided publicly embarrassing himself in front of millions of people on the internet.



Output from hmwk1.m

```
>> hmwk1
hmwk1
3x5 matrix
  0.3609    0.3770   -0.1876   -0.1640   -0.6658
 -0.2421    0.4808    0.2922    0.0504    0.0929
  0.3788   -0.0319   -0.2433    0.5460   -0.2902

Condition for 3x5 matrix
  2.0000

5x3 matrix
 -0.1328   -0.1946    0.0009
 -0.5262   -0.3879   -0.0221
  0.6563   -0.2392   -0.1324
 -0.0181    0.1220   -0.2453
  0.2193    0.0499   -0.7969

Condition for 5x3 matrix
  2.0000

square matrix
  0.2339   -0.0949    0.4207   -0.6330   -0.1879
  0.2922    0.3035    0.2834    0.1597    0.1659
 -0.2441    0.8129    0.1429   -0.3391    0.0694
 -0.3582   -0.2672    0.1433   -0.0150    0.5497
  0.3205   -0.1268   -0.3630   -0.3509    0.2572

Condition for square matrix
  2.0000
```