**Question 1**

1. Let f(w) = a⊤ (w ◦ b)

= Σi ai bi (w ◦ b)i

df(w) / dwi = ai bi

∇f(w) = (ai bi)⊤

∇f(w) = (a ◦ b)

1. f(w) = tr(Bww⊤A) = Σi, j Bi jwiwjAi j

df(w)/dwi = Σj (Bi j wj Aj i + Bj i wi Ai j)

= Σj Bi j (A⊤w)i + (Aw)i

∇f(w) = Σi (B(A⊤w)i + (Aw)i)

= BA(A⊤w) + B(Aw)

1. ∇f(w) = d/dw(tr(w⊤ABw))

= (AB + (AB)⊤)w

H = d2f(w)/dw2 = d/dw((AB + (AB)⊤)w)

= AB + (AB)⊤

1. Code in other file.
2. f(w) = log(σ(w⊤x))

σ(a) = 1/(1 + e-a)

σ(w⊤x) = 1/(1 + e-w^Tx)

f(w) = log(1/(1 + e-w^Tx)

∇f(w) = d/dw(log(1/(1 + e-w^Tx)))

∇f(w) = (e-w^Txx)/ (1 + e-w^Tx)