# CL Tut 4

## Ex1

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{a\wedge b\vdash a\wedge b}\,\text{I}}{a,b\vdash a\wedge b}\,\wedge R}{a,b,\neg(a\wedge b)\vdash}\,\neg L}{\neg(a\wedge b)\vdash \neg a,\neg b}\,\neg R,\neg R}{\neg(a\wedge b)\vdash \neg a\vee\neg b}\,\vee R$$

## Ex2:

$$\dfrac{\dfrac{\dfrac{\dfrac{}{\Gamma,x\vdash x,\Delta}\,\text{I}}{x,x\vee z\vdash x,y\wedge z}\,\vee L \qquad \dfrac{\dfrac{\dfrac{}{\Gamma,x\vdash x,\Delta}\,\text{I}}{y,x\vee z\vdash x,y\wedge z}\,\vee L \qquad \dfrac{\dfrac{\dfrac{}{\Gamma,y\vdash y,\Delta}\,\text{I}}{y,z\vdash x,y}\,\wedge R \qquad \dfrac{\dfrac{}{\Gamma,z\vdash z,\Delta}\,\text{I}}{y,z\vdash x,z}\,\wedge R}{y,z\vdash x,y\wedge z}\,\vee L}{y,x\vee z\vdash x,y\wedge z}\,\vee L}{x\vee y,x\vee z\vdash x,y\wedge z}\,\wedge L,\vee R}{(x\vee y)\wedge(x\vee z)\vdash x\vee(y\wedge z)}$$

## Ex3:

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{x\vdash x,\Delta}\,\text{I}}{x\vdash x,\neg y,z}\,\neg R \qquad \dfrac{\dfrac{}{\Gamma,y\vdash y,\Delta}\,\text{I}}{x,y\vdash y,z}\,\neg R}{x\vdash x\wedge y,\neg y,z}\,\wedge R \qquad \dfrac{\dfrac{}{z\vdash z,\Delta}\,\text{I}}{z\vdash x\wedge y,\neg y,z}\,\vee R}{x\vdash x\wedge y,\neg y\vee z}\,\vee R \qquad \dfrac{z\vdash x\wedge y,\neg y\vee z}{}\,\vee L}{x\vee z\vdash x\wedge y,\neg y\vee z}\,\neg R}{\vdash(x\wedge y),\neg(x\vee z),(\neg y\vee z)}\,\vee R,\vee R}{\vdash(x\wedge y)\vee(\neg(x\vee z)\vee(\neg y\vee z))}$$