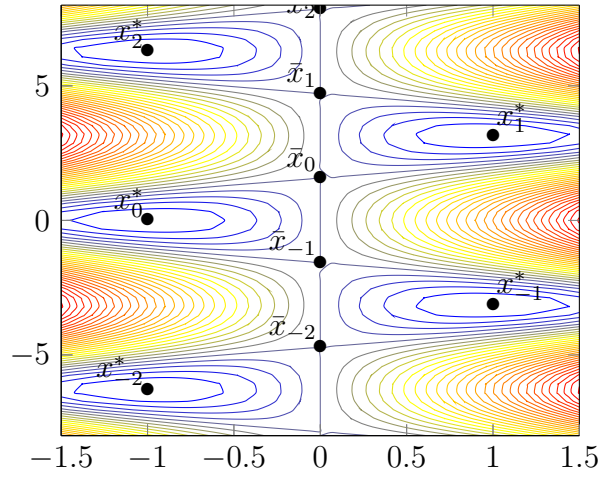


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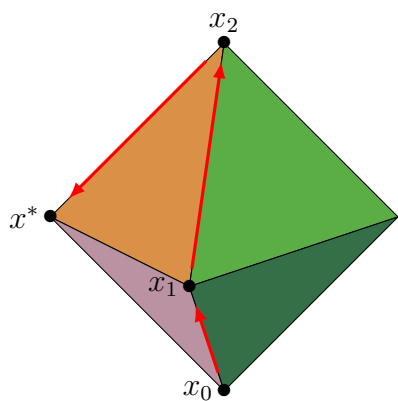


```

\begin{tikzpicture}
\begin{axis}[view={0}{90}, domain=-1.5:1.5, domain y=-8:8]
\addplot3[
contour gnuplot={labels=false, number=40, handler/.style=smooth},
samples=51,
] {0.5*x^2+x*cos(deg(y))};
\node[
label={left, xshift=1mm}  $x^*_0$ ,
minimum size=lpt
] at (axis cs: -1, 3.1415*0){\bullet} ;
\node[
label={right, xshift=-1mm}  $x^*_1$ ,
minimum size=lpt
] at (axis cs: 1, 3.1415*1){\bullet} ;
\node[
label={right, xshift=-1mm}  $x^*_{-1}$ ,
minimum size=lpt
] at (axis cs:1, -3.1415*1){\bullet};
\node[
label={left, xshift=1mm}  $x^*_{-2}$ ,
minimum size=lpt
] at (axis cs: -1, 3.1415*2){\bullet} ;
\node[
label={left, xshift=1mm}  $x^*_{-2}$ ,
minimum size=lpt
] at (axis cs: -1, -3.1415*2){\bullet} ;
\node[
label={left, xshift=1mm}  $\bar{x}_0$ ,
minimum size=lpt
] at (axis cs: 0, 1.5708*0*3.1415){\bullet} ;
\node[
label={left, xshift=1mm}  $\bar{x}_1$ ,
minimum size=lpt
] at (axis cs: 0, 1.5708*1*3.1415){\bullet} ;
\node[
label={left, xshift=1mm}  $\bar{x}_{-1}$ ,
minimum size=lpt
] at (axis cs: 0, 1.5708*-1*3.1415){\bullet} ;
\node[
label={left, xshift=1mm, yshift=-2mm}  $\bar{x}_{-2}$ ,
minimum size=lpt
] at (axis cs: 0, 1.5708*2*3.1415){\bullet} ;
\end{axis}
\end{tikzpicture}

```

Figure 1: 3d-07.tex: Level curves (Gnuplot)



```

\definecolor{pur}{RGB}{186, 146, 162}
\definecolor{cof}{RGB}{219, 144, 71}
\definecolor{greeo}{RGB}{91, 173, 69}
\definecolor{greet}{RGB}{52, 111, 72}
\begin{tikzpicture}[scale=4.6]
  \coordinate (A1) at (0, 0);
  \coordinate (A2) at (0.6, 0.2);
  \coordinate (A3) at (1, 0);
  \coordinate (A4) at (0.4, -0.2);
  \coordinate (B1) at (0.5, 0.5);
  \coordinate (B2) at (0.5, -0.5);

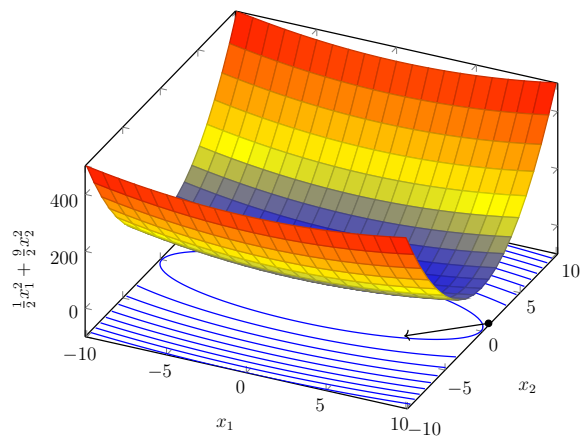
  \draw (A1) -- (A2) -- (A3);
  \draw (B1) -- (A2) -- (B2);

  \draw[fill=cof, opacity=0.3] (A1) -- (A4) -- (B1);
  \draw[fill=pur, opacity=0.3] (A1) -- (A4) -- (B2);
  \draw[fill=greeo, opacity=0.3] (A3) -- (A4) -- (B1);
  \draw[fill=greet, opacity=0.3] (A3) -- (A4) -- (B2);
  \draw (B1) -- (A1) -- (B2) -- (A3) --cycle;
  \node[draw=none] (a1) at (A1) {\bullet};
  \draw[left] (A1) node {\textit{x}^*};
  \node[draw=none] (b2) at (B2) {\bullet};
  \draw[left] (B2) node {\textit{x}_0};
  \node[draw=none] (a4) at (A4) {\bullet};
  \draw[left] (A4) node {\textit{x}_1};
  \node[draw=none] (b1) at (B1) {\bullet};
  \draw[above] (B1) node {\textit{x}_2};

  \draw[very thick, -latex, red] (b2) -- (a4);
  \draw[very thick, -latex, red] (a4) -- (b1);
  \draw[very thick, -latex, red] (b1) -- (a1);
\end{tikzpicture}

```

Figure 2: 3d-04.tex: Polytope

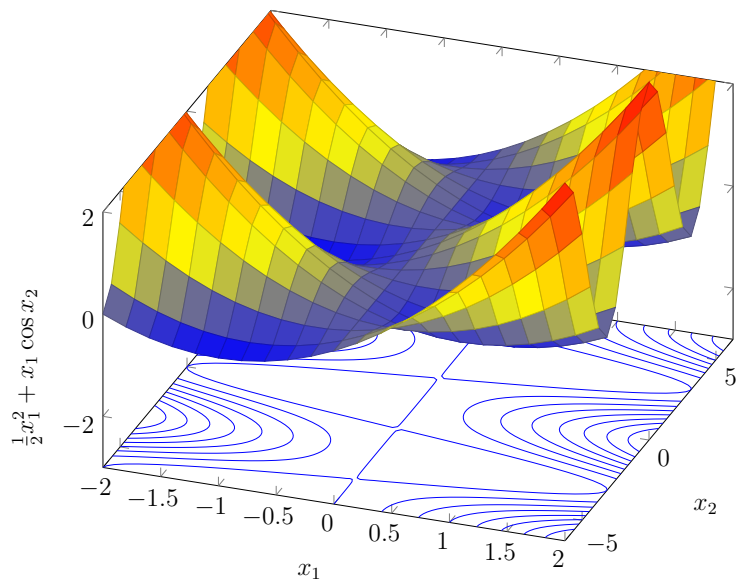


```

\begin{tikzpicture}[scale=0.6]
\begin{axis}[
width=12cm,
view={25}{45},
enlargelimits=false,
grid=none,
domain=-10:10,
y domain=-10:10,
xmin=-10.1,
xmax = 10.1,
zmin=-100,
zmax=500,
samples=21,
xlabel=$x_1$,
ylabel=$x_2$,
thick,
zlabel={$\frac{1}{2} x_1^2 + \frac{9}{2} x_2^2$}
]
\addplot3[
no markers,
blue,
raw gnuplot,
z filter/.code={\def\pgfmathresult{-100}},
mesh=false
] gnuplot {
set contour base;
set nosurface;
set cntrparam levels 15;
set isosamples 100;
set samples 50;
splot [-10:10][-10:10] 0.5 * x * x + 4.5 * y * y ;
};
\addplot3[surf] {0.5 * x * x + 4.5 * y * y} ;
\addplot3[mark=*, coordinates {(10, 1, -100)}];
\draw[thick,->] (axis cs:10, 1, -100) -- (axis cs:6.284, -2.345, -100) ;
\end{axis}
\end{tikzpicture}

```

Figure 3: 3d-01.tex: Function, level curves and iteration (Gnuplot)

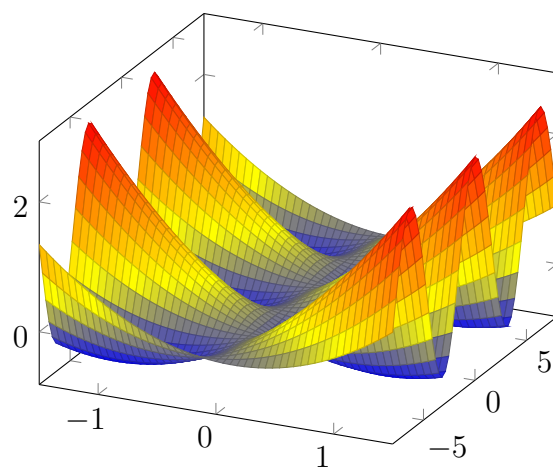


```

\begin{tikzpicture}[scale=0.8]
  \begin{axis}[
    width=12cm,
    view={20}{40},
    enlargelimits=false,
    domain=-2:2,
    y domain=-6.28:6.28,
    zmin=-3,
    zmax=2,
    samples=21,
    xlabel=$x_1$,
    ylabel=$x_2$,
    zlabel={\frac{1}{2} x_1^2 + x_1 \cos x_2},
  ]
    \addplot3[
      no markers,
      blue,
      raw gnuplot,
      z filter/.code={\def\pgfmathresult{ -3 }},
      mesh=false
    ] gnuplot {
      set contour base;
      set nosurface;
      set cntrparam levels 15;
      set isosamples 100;
      set samples 50;
      splot [-2:2][-6.28:6.28] 0.5 * x * x + x * cos(y) ;
    };
    \addplot3[surf,opacity=1] { 0.5 * x * x + x * cos(deg(y)) };
  \end{axis}
\end{tikzpicture}

```

Figure 4: 3d-02.tex: Function, level curves (Gnuplot)



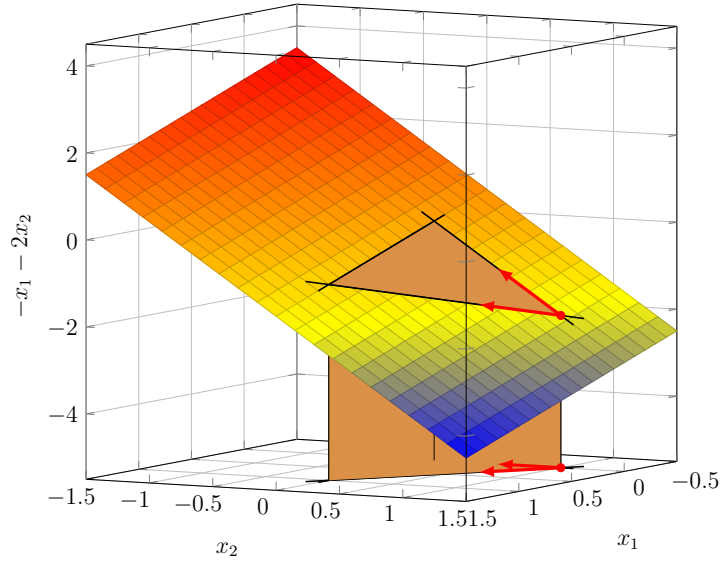
```

\begin{tikzpicture}
  \begin{axis}[
    domain=-1.5:1.5,
    domain y=-8:8
  ]
    \addplot3[
      surf,
      samples=51
    ]
      {0.5 * x^2 + x * cos(deg(y))};
  \end{axis}
\end{tikzpicture}

```

---

Figure 5: 3d-03.tex: Function

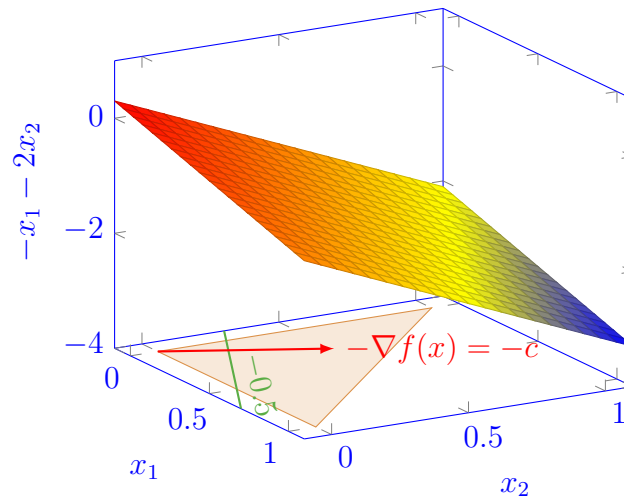


```

\definecolor{cof}{RGB}{219, 144, 71}
\begin{tikzpicture}[scale=0.75]
\begin{axis}[
  3d box,
  width=12cm,
  view={119}{6},
  enlargelimits=false,
  grid=major,
  domain=-0.5:1.5,
  y domain=-1.5:1.5,
  zmin=-5.5,
  zmax=4.5,
  samples=21,
  xlabel=$x_1$,
  ylabel=$x_2$,
  zlabel={$-x_1 - 2x_2$},
]
%Feasible set at the bottom
\addplot3[fill=cof, opacity=0.9] coordinates {(0, 0, -5.5) (1, 0, -5.5) (0, 1, -5.5)};
%Constraints at the bottom
\addplot3[thick] coordinates {(1.1, 0.0, -5.5) (-0.1, 0.0, -5.5)};
\addplot3[thick] coordinates {(-0.1, 1.1, -5.5) (1.1, -0.1, -5.5)};
\addplot3[thick] coordinates {(0.0, 1.1, -5.5) (0.0, -0.1, -5.5)};
%Vertical rectangles
\addplot3[fill=cof, opacity=0.1] coordinates {(0, 0, -5.5) (0, 0, 0) (1, 0, -1) (1, 0, -5.5)};
\addplot3[fill=cof, opacity=0.1] coordinates {(1, 0, -5.5) (1, 0, -1) (0, 1, -2) (0, 1, -5.5)};
\addplot3[fill=cof, opacity=0.1] coordinates {(0, 0, -5.5) (0, 0, 0) (0, 1, -2) (0, 1, -5.5)};
%Surface
\addplot3[surf, opacity=0.9] {-x - 2 * y};
%Feasible set on the surface
\addplot3[fill=cof, opacity=0.3] coordinates {(0, 0, 0) (1, 0, -1) (0, 1, -2)};
%Constraints on the surface
\addplot3[thick, opacity=0.9] coordinates {(1.1, 0.0, -1.1) (-0.1, 0.0, 0.1)};
\addplot3[thick, opacity=0.9] coordinates {(-0.1, 1.1, -2.1) (1.1, -0.1, -0.9)};
\addplot3[thick, opacity=0.9] coordinates {(0.0, 1.1, -2.2) (0.0, -0.1, 0.2)};
%Optimal solution
\addplot3[mark=*, red] coordinates {(0, 1, -2)};
\addplot3[mark=*, red] coordinates {(0, 1, -5.5)};
%Arrows
\addplot3[ultra thick, -latex, red] coordinates {
  (0, 1, -2)
  (0.35355339059327373, 0.6464466094067263, -1.6464466094067263)
};
\addplot3[ultra thick, -latex, red] coordinates {
  (0, 1, -5.5)
  (0.35355339059327373, 0.6464466094067263, -5.5)
};
\addplot3[ultra thick, -latex, red] coordinates {(0, 1, -2) (0.0, 0.5, -1.0)};
\addplot3[ultra thick, -latex, red] coordinates {(0, 1, -5.5) (0.0, 0.5, -5.5)};
\end{axis}
\end{tikzpicture}

```

Figure 6: 3d-05.tex: Linear function with constraints and directions



```

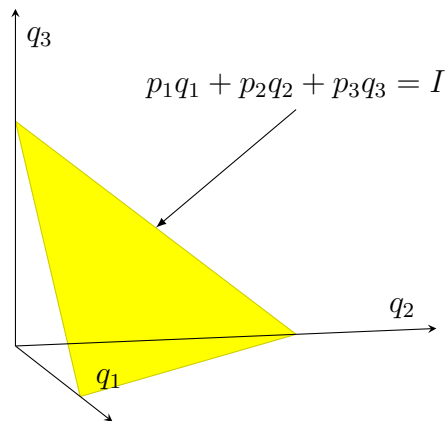
\definecolor{cof}{RGB}{219,144,71}
\definecolor{greeo}{RGB}{91,173,69}
\definecolor{greet}{RGB}{52,111,72}
\begin{tikzpicture}[blue]
  \begin{axis}[
    view={60}{20},
    enlargelimits=false,
    domain=-0.1:1.1,
    y domain=-0.1:1.1,
    zmin=-4,
    zmax=1,
    samples=21,
    xlabel=$x_1$,
    ylabel=$x_2$,
    zlabel={$-x_1 - 2x_2$},
  ]
    % Objective function
    \addplot3[surf, opacity=1] {-x -2*y };
    \draw[cof, fill=cof!20] {
      (axis cs:0, 0, -4) --
      (axis cs: 0, 1, -4) --
      (axis cs: 1, 0, -4) -- (axis cs:0, 0, -4)}
    ;
    % Level curve -0.5
    \draw[
      greeo,
      thick
    ] (axis cs: -0.1, 0.3, -4) -- (axis cs: 1.1, -0.3, -4)
    node[midway, above, sloped] (f1) {$-0.5$} ;

    \draw[red, -latex, thick] (axis cs:0, 0) -- (axis cs:0.25, 0.5)
    node[right] {$-\nabla f(x) = -c$};
  \end{axis}
\end{tikzpicture}

```

Figure 7: 3d-06.tex: Linear function with constraints, directions and gradient





```

\begin{tikzpicture}
  \begin{axis}[view={77}{13},
    axis lines=middle,
    axis on top,
    ticks=none,
    clip=true,
    patch,
    xlabel={\mathit{q}_1},
    ylabel={\mathit{q}_2},
    zlabel={\mathit{q}_3},
    samples=50,
    xmin=0,
    xmax=1.5,
    ymin=0,
    ymax=1.5,
    zmin=0,
    zmax=1.5,
    domain=0:1,
    domain y=0:1,]
    \addplot3[surf] coordinates {
      (1,0,0)
      (0,1,0)
      (0,0,1)
    };
    \node[anchor=south] at (0, 1, 1) {\mathit{p}_1\mathit{q}_1 + \mathit{p}_2\mathit{q}_2 + \mathit{p}_3\mathit{q}_3 = I};
    \draw[-latex] (0, 1, 1) -- (0, 0.5, 0.5) ;
  \end{axis}
\end{tikzpicture}

```

Figure 8: 3d-08.tex: Simplex