Start

Vi starter på nytt

```
restart;
```

Vi lader inn kommandopakkene

```
with(plots);
```

[*animate*, *animate3d*, *animatecurve*, *arrow*, *changecoords*, *complexplot*, *complexplot3d*, *conformal*, *conformal3d*, *contourplot*, *contourplot3d*, *coordplot*, *coordplot3d*, *densityplot*, *display*, *dualaxisplot*, *fieldplot*, *fieldplot3d*, *gradplot*, *gradplot3d*, *implicitplot*, *implicitplot3d*, *inequal*, *interactive*, *interactiveparams*, *intersectplot*, *listcontplot*, *listcontplot3d*, *listdensityplot*, *listplot*, *listplot3d*, *loglogplot*, *logplot*, *matrixplot*, *multiple*, *odeplot*, *pareto*, *plotcompare*, *pointplot*, *pointplot3d*, *polarplot*, *polygonplot*, *polygonplot3d*, *polyhedra_supported*, *polyhedraplot*, *rootlocus*, *semilogplot*, *setcolors*, *setoptions*, *setoptions3d*, *spacecurve*, *sparsematrixplot*, *surfdata*, *textplot*, *textplot3d*, *tubeplot*] **(1.1)**

```
with(Student[VectorCalculus]);
```

[*&x*, `*`, `+`, `-`, `.`, *<,>*, *<|>*, *About*, *ArcLength*, *BasisFormat*, *Binormal*, *ConvertVector*, *CrossProduct*, *Curl*, *Curvature*, D, *Del*, *DirectionalDiff*, *Divergence*, *DotProduct*, *FlowLine*, *Flux*, *GetCoordinates*, *GetPVDescription*, *GetRootPoint*, *GetSpace*, *Gradient*, *Hessian*, *IsPositionVector*, *IsRootedVector*, *IsVectorField*, *Jacobian*, *Laplacian*, *LineInt*, *MapToBasis*, *Nabla*, *Norm*, *Normalize*, *PathInt*, *PlotPositionVector*, *PlotVector*, *PositionVector*, *PrincipalNormal*, *RadiusOfCurvature*, *RootedVector*, *ScalarPotential*, *SetCoordinates*, *SpaceCurve*, *SpaceCurveTutor*, *SurfaceInt*, *TNBFrame*, *Tangent*, *TangentLine*, *TangentPlane*, *TangentVector*, *Torsion*, *Vector*, *VectorField*, *VectorFieldTutor*, *VectorPotential*, *VectorSpace*, *diff*, *evalVF*, *int*, *limit*, *series*] **(1.2)**

```
with(Student[MultivariateCalculus]);
```

[*ApproximateInt*, *ApproximateIntTutor*, *CenterOfMass*, *ChangeOfVariables*, *CrossSection*, *CrossSectionTutor*, *Del*, *DirectionalDerivative*, *DirectionalDerivativeTutor*, *FunctionAverage*, *Gradient*, *GradientTutor*, *Jacobian*, *LagrangeMultipliers*, *MultiInt*, *Nabla*, *Revert*, *SecondDerivativeTest*, *SurfaceArea*, *TaylorApproximation*, *TaylorApproximationTutor*] **(1.3)**

```
with(Student[VectorCalculus]);
```

[*&x*, `*`, `+`, `-`, `.`, *<,>*, *<|>*, *About*, *ArcLength*, *BasisFormat*, *Binormal*, *ConvertVector*, *CrossProduct*, *Curl*, *Curvature*, D, *Del*, *DirectionalDiff*, *Divergence*, *DotProduct*, *FlowLine*, *Flux*, *GetCoordinates*, *GetPVDescription*, *GetRootPoint*, *GetSpace*, *Gradient*, *Hessian*, *IsPositionVector*, *IsRootedVector*, *IsVectorField*, *Jacobian*, *Laplacian*, *LineInt*, *MapToBasis*, *Nabla*, *Norm*, *Normalize*, *PathInt*, *PlotPositionVector*, *PlotVector*, *PositionVector*, *PrincipalNormal*, *RadiusOfCurvature*, *RootedVector*, *ScalarPotential*, *SetCoordinates*, *SpaceCurve*, *SpaceCurveTutor*, *SurfaceInt*, *TNBFrame*, *Tangent*, *TangentLine*, *TangentPlane*, *TangentVector*, *Torsion*, *Vector*, *VectorField*, *VectorFieldTutor*, *VectorPotential*, *VectorSpace*, *diff*, *evalVF*, *int*, *limit*, *series*] **(1.4)**

Taylors formel

Vi jobber med denne funksjonen (på undervisningen jeg har tegnet sin(2x)-cos(y) med maple når vi har sett på annenderiverttesten)

$$f := (x, y) \rightarrow \cos(2 \cdot x) - \sin(y);$$

$$(x, y) \rightarrow \cos(2\,x) + \mathit{Student:-VectorCalculus:-`-`}(\sin(y)) \tag{2.1}$$

Gradienten til f er

$$\mathit{Gradient}(f(x, y))$$

$$-2\sin(2\,x)\bar{e}_x - \cos(y)\bar{e}_y \tag{2.2}$$

Vi finner de kritiske punktene: løs Grad f = 0

$$\mathit{solve}(\mathit{convert}(\mathit{Gradient}(f(x, y)), \mathit{list}), \{x, y\}, \mathit{allsolutions})$$

$$\left\{x = \frac{1}{2}\,\pi\,\_Z3\sim,\ y = \frac{1}{2}\,\pi + \pi\,\_Z4\sim\right\} \tag{2.3}$$

Vi ser at det fins uendelig mange kritiske punkter og de er gitt i denne formen: (1/2 π * K , 1/2 π + L * π), hvor K og L er helltall

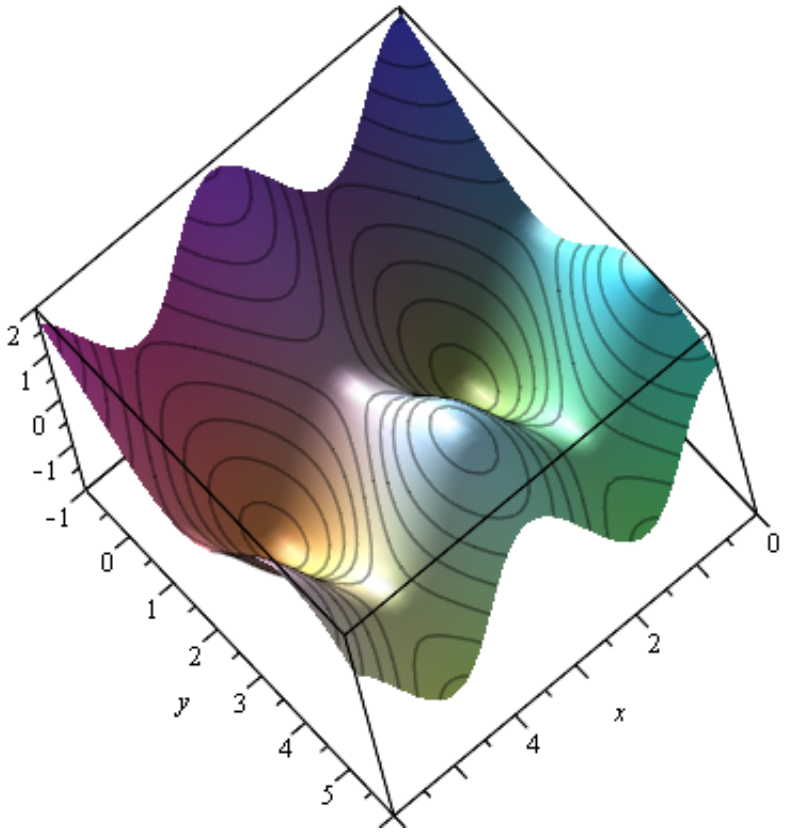
Vi velger 3 forskjellige punkter fra listen og ber MAPLE til å gjøre annenderiverttesten

$$\mathit{SecondDerivativeTest}\left(f(x, y), [x, y] = \left[\left[\frac{\mathrm{Pi}}{2}, \frac{\mathrm{Pi}}{2}\right], \left[\frac{\mathrm{Pi}}{2}, \frac{3 \cdot \mathrm{Pi}}{2}\right], \left[0, \frac{3 \cdot \mathrm{Pi}}{2}\right]\right]\right)$$

$$\mathit{LocalMin} = \left[\left[\frac{1}{2}\,\pi, \frac{1}{2}\,\pi\right]\right], \mathit{LocalMax} = \left[\left[0, \frac{3}{2}\,\pi\right]\right], \mathit{Saddle} = \left[\left[\frac{1}{2}\,\pi, \frac{3}{2}\,\pi\right]\right] \tag{2.4}$$

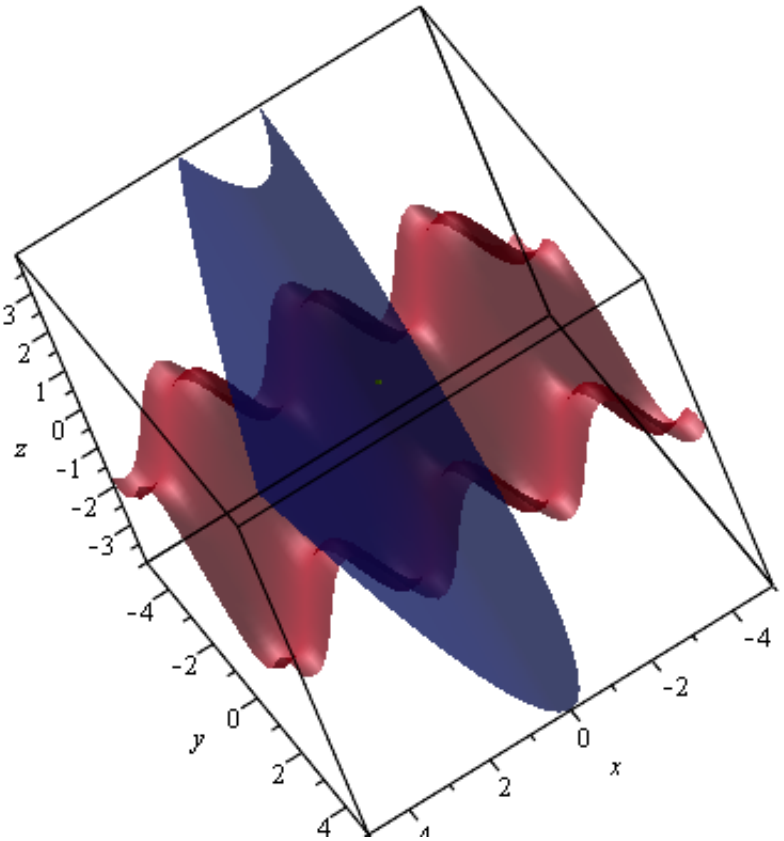
Finn disse punktene på grafen!

$$\mathit{plot3d}(f(x, y), x = 0..6, y = -1..6, \mathit{axes} = \mathit{boxed}, \mathit{style} = \mathit{patchcontour})$$

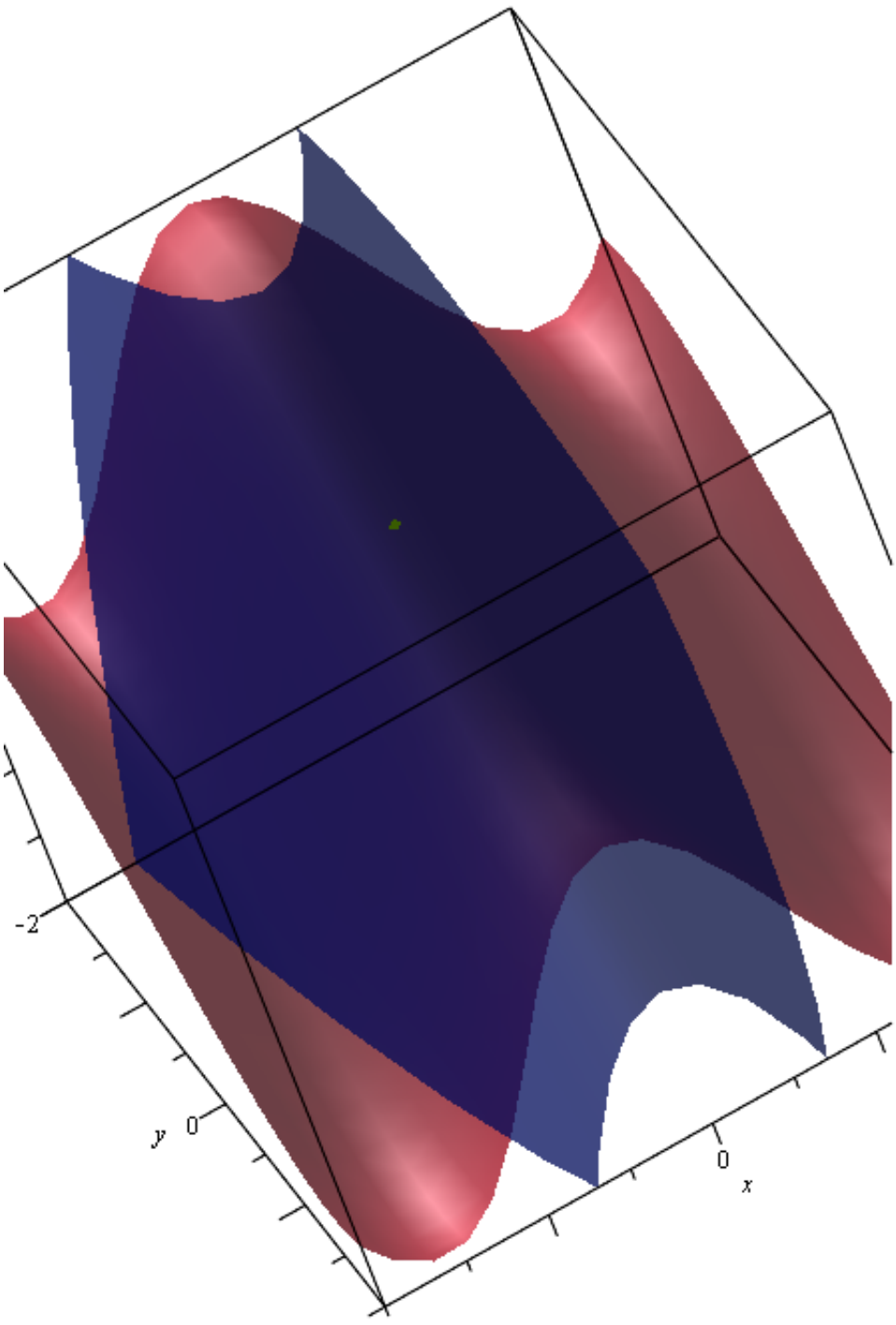


Den kvadratiske approksimasjonen til f nær (0,0) (bruk Degree = 2)

```
TaylorApproximationTutor(cos(2*x) — sin(y), [x, y] = [0, 0], 2, view = [ -2 .. 2, -2 .. 2, -2
    .. 2 ]);
```



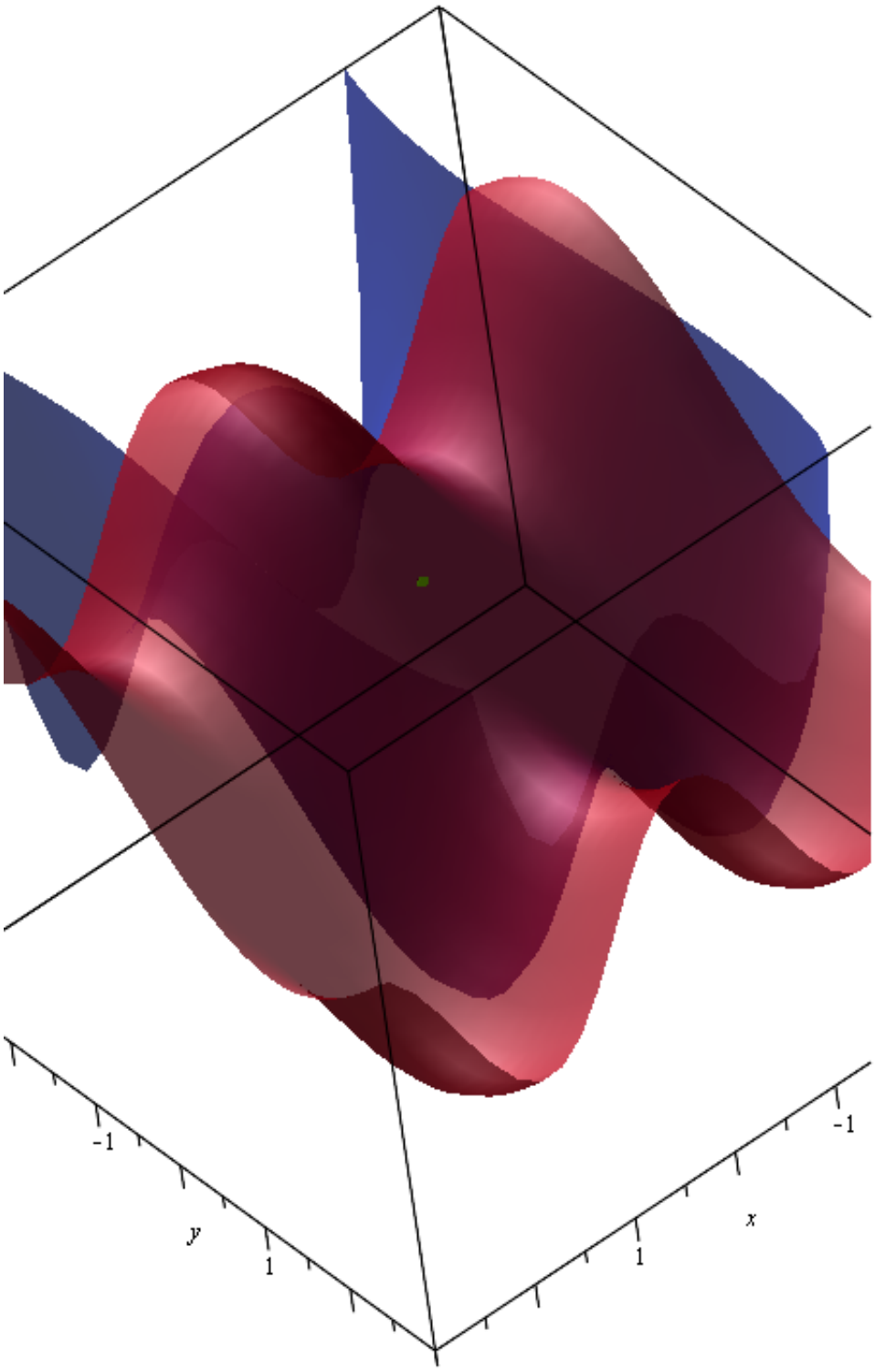
TaylorApproximation(cos(2 * *x*) — sin(*y*), [*x*, *y*] = [0, 0], 2, *view* = [-2 .. 2, -2 .. 2, -2 .. 2],
output = *plot*, *axes* = *boxed*, *scaling* = *unconstrained*);



At $(0, 0)$, the Taylor polynomial of degree 2 for $f(x, y) = \cos(2x) - \sin(y)$. The figure includes the function drawn in burgundy.

Approksimasjoner for f nær (0,0): order 1 (lineær), order 2 (kvadratisk), order 3, ..., order 10
Legg merke til at den blir bedre og bedre (detter en animasjon)

```
TaylorApproximation( cos(2 * x) — sin(y), [x, y] = [0, 0], 10, view = [ -3 .. 3, -3 .. 3, -3 .. 3 ],
    output = animation, axes = boxed, scaling = unconstrained, caption = "" );
```


-1
y
1
1
x
-1