Practical 5

P.D.E

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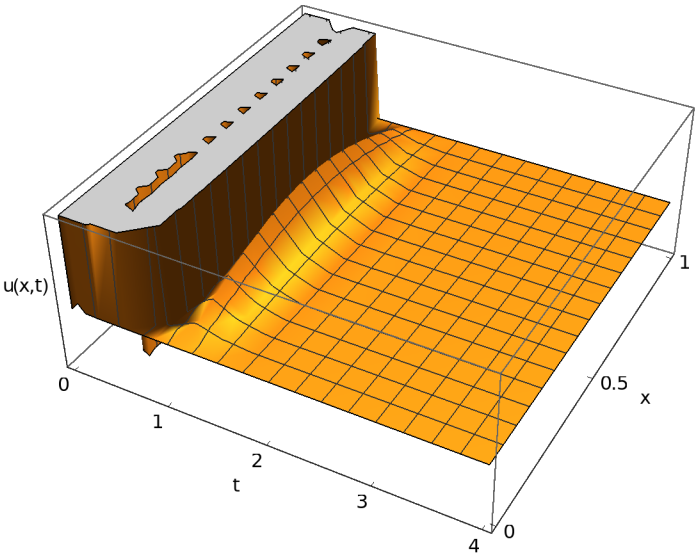
Question : $u_t = 4\, u_{xx}$, $u[x, 0] = x^2 (1 - x)$, $u[0, t] = 0$, $u[1, t] = 0$, $0 < x < 1$, $t > 0$;

In[19]:=
```
Solution :
  eqn = {D[u[x, t], t] == 4 * D[u[x, t], {x, 2}], u[x, 0] == x^2 * (1 - x^2), u[0, t] == 0, u[1, t] == 0}
sol1 = u[x, t] /. NDSolve[eqn, u[x, t], {x, 0, 1}, {t, 0, 4}, PrecisionGoal → 3][[1]]
Plot3D[sol1, {t, 0, 4}, {x, 0, 1}, AxesLabel → {"t", "x", "u(x,t)"},
 Ticks → {{0, 1, 2, 3, 4}, {0, 0.5, 1}, {-1, 1}}]
```

Out[19]= $\left\{u^{(0,1)}[x, t] == 4\, u^{(2,0)}[x, t],\ u[x, 0] == x^2 \left(1 - x^2\right),\ u[0, t] == 0,\ u[1, t] == 0\right\}$

Out[20]= InterpolatingFunction[ Domain: {{0., 1.}, {0., 4.}}
Output: scalar][x, t]

Out[21]=

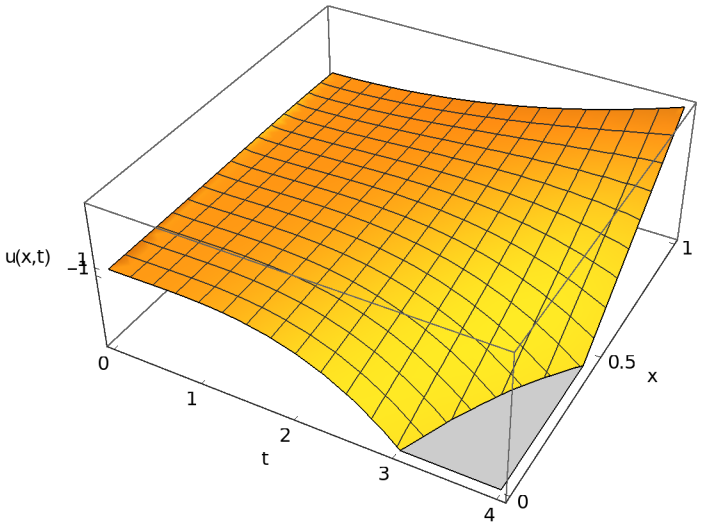


In[25]:=
```
question : eqn = {2 D[u[x, t], t] == 5 * D[u[x, t], {x, 2}],
   u[x, 0] == Sin[x^2] * (1 - x^4), u[0, t] == t^2 * (1 - t), u[1, t] == t^2}
sol1 = u[x, t] /. NDSolve[eqn, u[x, t], {x, 0, 1}, {t, 0, 4}, PrecisionGoal → 3][[1]]
Plot3D[sol1, {t, 0, 4}, {x, 0, 1}, AxesLabel → {"t", "x", "u(x,t)"},
 Ticks → {{0, 1, 2, 3, 4}, {0, 0.5, 1}, {-1, 1}}]
```

Out[25]=
$$\left\{2\, u^{(0,1)}[x, t] == 5\, u^{(2,0)}[x, t],\ u[x, 0] == \left(1 - x^4\right) \text{Sin}\left[x^2\right],\ u[0, t] == (1 - t)\, t^2,\ u[1, t] == t^2\right\}$$

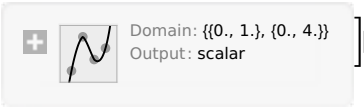
Out[26]=
$$\text{InterpolatingFunction}\left[\ \text{Domain: } \{\{0., 1.\}, \{0., 4.\}\}\ \text{Output: scalar}\ \right][x, t]$$

Out[27]=

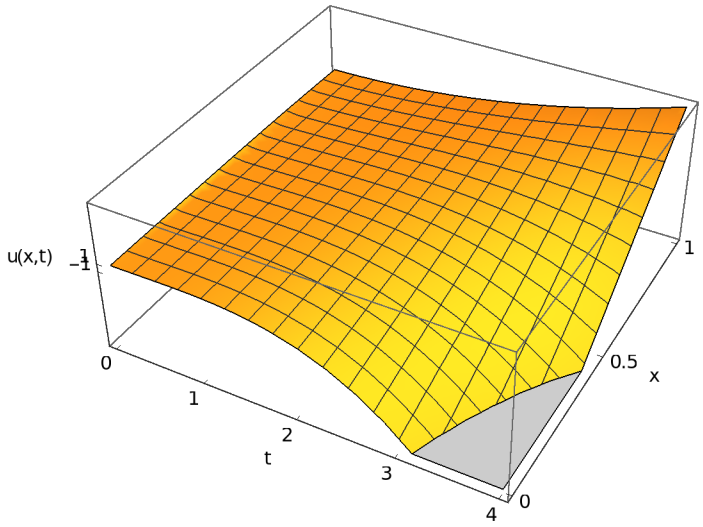


In[7]:=
```
question :
  eqn = {D[u[x, t], t] == 9 * D[u[x, t], {x, 2}],
  u[x, 0] == Sin[x] * (1 - x^3), u[0, t] == t^2 * (1 - t), u[1, t] == t^2}
sol1 = u[x, t] /. NDSolve[eqn, u[x, t], {x, 0, 1}, {t, 0, 4}, PrecisionGoal → 3][[1]]
Plot3D[sol1, {t, 0, 4}, {x, 0, 1}, AxesLabel → {"t", "x", "u(x,t)"},
 Ticks → {{0, 1, 2, 3, 4}, {0, 0.5, 1}, {-1, 1}}]
```

Out[7]= $\left\{u^{(0,1)}[x, t] == 9\, u^{(2,0)}[x, t],\ u[x, 0] == \left(1 - x^3\right) \text{Sin}[x],\ u[0, t] == (1 - t)\, t^2,\ u[1, t] == t^2\right\}$

Out[8]= InterpolatingFunction[ [x, t]

Out[9]=



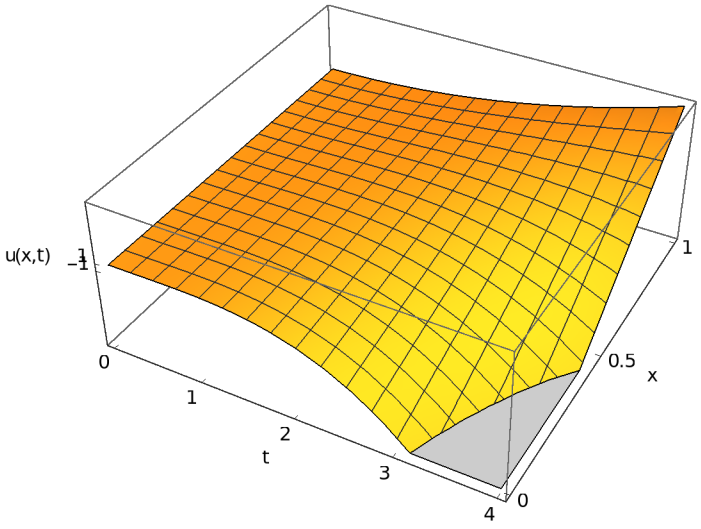

```
question : eqn =
 {3 D[u[x, t], t] == 5 * D[u[x, t], {x, 2}], u[x, 0] == x^3 * (1 - x^2), u[0, t] == 0, u[1, t] == 0}
```

In[10]:=
```
sol1 = u[x, t] /. NDSolve[eqn, u[x, t], {x, 0, 1}, {t, 1, 4}, PrecisionGoal → 3][[1]]
Plot3D[sol1, {t, 0, 4}, {x, 0, 1}, AxesLabel → {"t", "x", "u(x,t)"},
 Ticks → {{0, 1, 2, 3, 4}, {0, 0.5, 1}, {-1, 1}}]
```

Out[10]=
```
InterpolatingFunction[  Domain: {{0., 1.}, {1., 4.}}
Output: scalar ][x, t]
```

InterpolatingFunction: Input value {0.0000715, 0.000286} lies outside the range of data in the interpolating function. Extrapolation will be used.

Out[11]=



NDSolve: Equation or list of equations expected instead of eqn1 in the first argument eqn1.

ReplaceAll: {eqn1} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

Out[14]=
```
u[x, t] /. eqn1
```

ReplaceAll: {eqn1} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

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General: Further output of ReplaceAll::reps will be suppressed during this calculation.

In[16]:=
```
question : eqn = {2 D[u[x, t], t] == 5 * D[u[x, t], {x, 2}],
   u[x, 0] == Sin[x^2] * (1 - x^4), u[0, t] == t^2 * (1 - t), u[1, t] == t^2}
sol1 = u[x, t] /. NDSolve[eqn, u[x, t], {x, 0, 1}, {t, 0, 4}, PrecisionGoal → 3][[1]]
Plot3D[sol1, {t, 0, 4}, {x, 0, 1}, AxesLabel → {"t", "x", "u(x,t)"},
 Ticks → {{0, 1, 2, 3, 4}, {0, 0.5, 1}, {-1, 1}}]
```

Out[16]=
$$\left\{2\, u^{(0,1)}[x, t] == 5\, u^{(2,0)}[x, t],\ u[x, 0] == \left(1 - x^4\right) \text{Sin}\left[x^2\right],\ u[0, t] == (1 - t)\, t^2,\ u[1, t] == t^2\right\}$$

Out[17]=
InterpolatingFunction[Domain: {{0., 1.}, {0., 4.}} Output: scalar][x, t]

Out[18]=