

# PTRL3040

BiaYf]WU`FYgYfjc]fG]ai`Uh]cb

PTRL3040 Term 3, 2020 published at 13-09-2020 // © University of New South Wales, 2020

# 7 ci fgY<sup>-</sup>Cj Yfj ]Yk

## GHJZZ7cbHJWh78YHJ]`g

#### 7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]m	@cWUh]cb	D∖cbY
:ifeUb <sup>:</sup> @Y! <iggu]b< td=""><td>∄ feUb"∖i ggU]b4 i bgk "YXi "Ui</td><td>cb`]bY`fHYUa gŁ</td><td>Н9Н6`&amp;%-</td><td></td></iggu]b<>	∄ feUb"∖i ggU]b4 i bgk "YXi "Ui	cb`]bY`fHYUa gŁ	Н9Н6`&%-	

#### 8Ya cbghfUhcfg

B Ua Y	9a U]`	5j U]`UV]`]hm	@cWUhjcb	D∖cbY
<ub[ 'm]b<="" td=""><td>n) % -' (' 4 i bgk "YXi "Ui</td><td>cb`]bY</td><td>Н9Н6</td><td></td></ub[>	n) % -' (' 4 i bgk "YXi "Ui	cb`]bY	Н9Н6	

88

#### GWXcc``7cbHJWhi=bZcfaUhjcb

GW&cc``cZA]bYfU`g`UbX`9bYf[mFYgcifWYg C`X`AU]b`6i]`X]b[ž`@YjY``%z`%)-`f?%)Ł IBGK `GM8B9MBGK`&\$)&5IGHF5@=5

พพเป็

H. Ž\*%f&Ł-',)))\$\$\*

9. <u>a YfY"hYUWX]b[4 i bgk "YXi "Ui</u> K. <u>k k "Yb[]bYYf]b["i bgk "YXi "Ui #a ]bYf000%,b¥f[ mfYec1 fV¥g</u>

# 7cifgY<sup>·</sup>8YHJ]`g

#### 7 fYX]hDc]bhg\*\*\*

#### Gi a a UfmcZh\Y'7ci fgY

H\]gʻWcifgYʻU]agʻncʻ]bhfcXiWYʻn\YʻghiXYbhincʻn\YʻVUW\_[fcibX`\_bck`YX[Y`]bʻbiaYf]WU``fYgYfjc]fʻg]ai`Uhjcb k\]W\`]gʻUʻk]XY`migYX`ncc``]bʻdYhfc`Yiaʻ]bXighfmUbX`fYgYUfW\`UbX`[i]XYʻn\YʻghiXYbhinc``YUfbʻ\ck`nc gc`jY`fYgYfjc]f`Yb[]bYYf]b[`dfcV`Yagʻn\fci[\`n\Y`dfcZygg]cbU``igY`cZbiaYf]WU``fYgYfjc]f`g]ai`Uhjcb''

H\]gʻWcifgYʻUʻgcʻUʻdUfhicZh\YʻaUh\YaUh]WgʻfYei]fYaYbhicZh\YʻghfYUa"``H\YgYʻWcifgYgʻ]bjcʻjY XYjY`cdaYbhicZZck`acXY`gʻfdUfh]U``X]ZZyfYbh]U``YeiUh]cbłžUbU`mh]WU``UbX`biaYf]WU``gc`ih]cb"`H\Y \_bck`YX[Y`UbX`g\_]``gʻ]bʻh\YgY`WcifgYgʻ]bWiXY.`dUfh]U``X]ZZyfYbh]U``YeiUh]cbgžVcibXUfmWcbX]h]cbgž biaYf]WU``X]ZZyfYbh]Uh]cb`UbX`]bhY[fUh]cbžaUhf]I`cdYfUh]cbgžgc`ih]cbcZaUhf]Wfgʻig]b[`YIUWhUbX`]hYfUh]jY aYh\cXgžYffcfg`UggcW]UhYX`k]h\`biaYf]WU``gc`ih]cbg"

### 7 ci fgY 5]a g

- % =blfcXi WY h\Y`gh XYbhic h\Y`VUW[fci bX`\_bck x[Y`]bbi a Yfwb`fYgYfj c]f`g]a i `Uhjcb`k \]W\`]g`U k ]XY`mi gYX`hcc``]b`dYhfc`Yi a `]bXi ghfmUbX`fYgYuww
- &"; i]XY'H\Y'gh XYbhbc``YUfb`\ck 'h<mark>e</mark>nge,j Y'fYg**%f a**}FYb[]bYYf]b['dfcV`Ya g'h\fci [\`H\Y'dfcZYgg]cbU` igY'cZbi a Yf]WU``fYgYfj c]f`g]a i`U**Vg**

#### 7 ciffg \& @\Ufp ]b [h\Ca \\ @ a \\ a \\ @ a \\ a \\ @ a \\ a

- % [U]b'\_bck X [x] UbX a for a YUbg'cZ bi a Yf]WU`H/W biei YgZ a
- &" Udd`m]bHY[fUh<sup>A</sup>%\_bc<sub>k</sub><sup>A</sup>/%[Y`cZa Uh`UbX`VUg]WgW]YbWYg`]bWi X]b[`[YcgW]YbWYg`hc`h\Y`gc`i h]cb`cZ dfcV`Ya g`fY`UhYX\*<mark>a</mark> Zh`JX`Zck `]b`dcfci g`a YX]U`UbX`fYgYfj c]f`dYfZcfa UbWY`dfYX]W]cbg

#### Hihcf]U`!@YWhifY`Z]dd]b[

Ghi XYbhgʻUfYʻWLUʻYb[YX'hcʻgcʻjYʻUʻh'hcf]Uʻei Ygh]cbʻVYZcfYʻh.YʻfYʻUhYX'hcd]W\UgʻVYYbʻX]gWʻggYXʻ]bʻh.Y 'YWhʻfY''H\Yʻghi XYbhgʻk]``k cf\_`]bʻ[fci dg'': ]fghih.Ymk]``X]gWʻggʻh.YʻdfcVʻYaʻghUhYa Ybhk]h.YhY]fʻdYYfg UbX`]XYbh]Zmh\YʻdfcVʻYa "'Hi hcfgʻk]``[YhZYXVUW\_Zfcaʻj Uf]ci gʻ[fci dgʻUbX`[i]XYʻh.Ya']Zh.Y]fʻdfcVʻYa ]XYbh]Z]WUh]cbʻ]gʻ]bWcffYWhʻ5ZhYfk UfXgžh.Ymk]``]XYbh]Zmdcgg]VʻYʻgcʻi h]cbʻa Yh\cXgʻUbX`Z]bU`mgcʻjYʻh.Y dfcVʻYa "'5[U]bžih hcfgʻk]``]bWfYa YbHU`m[i]XYbh]Zmdcgg]VʻYʻgcʻi h]cbʻaZh\cXgʻUbX`Z]bU`mgcʻjYʻh.Y WcbWi g]cbgʻXfUk bʻZfcaʻh.Yʻh hcf]U``U`][bʻk]h.'h.YʻVUg]Whcd]WgʻZcfʻh.YʻZc``ck]b[``YWhi fY''H\]gʻa YUbgʻh.Uh']b h.Y``YWhi fYžh.Y``YWhi fYfWJbʻWcbWrbhfUhYʻa cfYʻcbʻh.YʻUXj UbWrXʻcfʻa cfY`Wca d`]WJhYX'dUfhcZh.Y'hcd]W i bXYf`X]gW gg]cb''

a dfcj YX 5ggYgga Ybh# YYXVUW\_ hYW b]ei Yg

ŧð ʿUXX]h]cb ˈhc ˈh∖ Y ʿWcbj Ybh]cbU``UddfcUW\Ygžk Y ʿgi [[YghīZc``ck ]b[ ˈhYW\b]ei Yg

%"`5hh\YYbX'cZYjYfmhYUW\]b['kYY\_žghiXYbhg'k]``gc`jY'Ub'cb`]bY'ei]n'k\]W\'k]``hYghh\Y]f`\_bck`YX[Y" H\YgY'ei]nnYg'k]``bchVY'U'dUfhcZh\Y'ZbU``UggYggaYbhVihk]``dfcj]XY'ZcfaUhjjY'ZYXVUW\_'hc'ghiXYbhg UbX'[i]XY']bghfiWhcfg']b'h\Y]f`hYUV\]b["

&"``DYYf'ZYYXVUW\_'Zc``ck ]b[ `h hcf]U`g"`H\]g'k ]``bchVY`dUfhicZh\Y`Z]bU``UggYgga Ybh

'"``Cb`]bY'ei]nh]cb

# 5ggYgga Ybh

#### 5ggYgga YbhHUg\_g

5ggYgga Ybh'HJg_	K Y][∖h	8iY`8UHY	Ghi XYbhï@YUfb]b[ Ci hWca Ygʻ5ggYggYX
Dfc Y Wri	&) ı	% #%%#&\$&\$`%%\$\$`DA	%ž`&
Ei]n	&) I	&, #%\$#&\$&\$`\$+.\$\$`DA	%ž`&ž`'
: ]bU``9I Ua `	) \$1	I BGK "H]a YHUV"Y	%ž`&ž`'

#### 5ggYgga Ybh8YHJ]`g

5ggYgga Ybh% Dfc YWh

8YHJ]`g.Ghi XYbhg`k]```bYYX`hc`dfYX]Wih\Y`dYfZcfa UbWY`cZU`fvgYfj`c

Hi fb]h]b`gYh]b[.`H\]g`]g`bchU`Hi fb]h]b`Ugg][ ba Ybh

5ggYgga Ybh& Ei]n

GHJfh'XUHY. \*&, #%\$#&\$&\$\*\$).\$\$\*ĎAw

wwill

8YHJ]`g.

Ei]n']b'kYY\_!+

5ggYgga Ybh' .∵]bU∵9l Üa

8YHJ]`g.: ]bU``YI Ua

## 5 HHYbXUbWY FYei ]fYa Ybhg

Ghi XYbhgʻUfYʻghfcb[`mʻYbWci fU[YX'hcʻUhhYbX'U```WUggYgʻUbX'fYj]Yk ``YWhi fYʻfYWcfX]b[g"

# 7 ci fgY GWX YXi `Y

#### J]Yk WUgg ha YHJV Y

#### H]a YHJV`Y'

8 UHY	Hmd Y	7 cbhYbh
C K YY, GYdHYa VYf?!- GYdHYa VYf		
K YY_'%`%(`GYdhYa VYf'! % `GYdhYa VYf		=əhfcXiWMjcb`hc`U`g]ai`Uhjcb`ghiXm
K YY_'&.'&%GYdHYa VYf'! &) 'GYdHYa VYf		G]a i `Uhcf`Yer Uhjobg`#
KYY_"&, GYdhYaVYf"! &CWbcVYf	<u>п</u> ~ »8	Gai Ur Fyni Uhoog #
K YY (.), C W/c VYf'!'-		₩WWW`fYgYfjc]f`g]ai`Uh]cb BiaYflWU`Gc`ihcbo#
C ₩cVYf		DfUWjWU`fYgYfjc]f`g]ai`Uhjcb
KYY_`).'%&'CW/cV//f'!%* CW/cVYf		BiaYf]WU``Gc`ih]cbg# DfUWf]WU``fYgYfjc]f`g]ai`Uh]cb
KYY_'*.'%-'CW/cVYf'!'& CW/cVYf	8 8	Cb`]bY`X]gW gg]cbg#Yj ]g]cb`fcdh]cbU`Ł
K YY_`+.`&*`C₩bcVYf`!`'\$ C₩bcVYf		A cXY``]b]hJU`]nUhJcb
K_YY_`, .`&'Bcj Ya VYf'!`* Bcj Ya VYf		HfYUha YbhicZk Y``g
K YY_``-`Bcj Ya VYf'! % `Bcj Ya VYf		DgYi Xc!Z bWgcbg
K YY_`%\$.`%*`Bcj Ya VYf'! &\$`Bcj Ya VYf		7C&GYeiYghfUhjcb

FYgci fWfg

DfYgWf]VYX FYgci fWYg

BchUjU]`UV`Y

FYWca a YbXYX FYgci fWYg

BchUjU]`UV`Y

### 7 ci fgY'9j U`i Uh]cb'UbX'8Yj Y`cda Ybh

5 htty:YbX:cZYUWX:WeifgYžU```ghiXYbhgik]``\UjY:hty:cddcfhib]hmhc:Wead`YhY:U'WeifgY:YjU`iUh]eb:Zefa" H\YgY:Ubebmacig`gifjYmg`\Y`d`ig`ibXYfghUbX:meif`j]Ykg`cZhty:WeifgYžmeif``YWhifYfg`UbX:hty:WeifgY



Gi Va ]gg]cb<sup>-</sup>cZ<sup>-</sup>5ggYgga Ybh<sup>-</sup>HUg\_g



# 5WUXYa ]W<cbYghmUbX D`U[ ]Uf]ga

Mci f``YWi fYf`UbX`h\Y`I b]j Yfg]mik ]``YI dYWinci f`gi Va ]hYX`Ugg][ ba Ybhg`UfY`hfi `minci f`ck b`k cf\_"`I BGK \Ug`j YfmWYUf`[ i ]XY`]bYg`cb`k \Uhd`U[ ]Uf]ga `]g`UbX`\ck `hc`Uj c]X`]h'`D`U[ ]Uf]ga `]g`i g]b[ `h\Y`k cfXg`cf ]XYUg`cZch\Yfg`UbX`dfYgYbh]b[ `h\Ya `Ug`nci f`ck b"`D`U[ ]Uf]ga `]g`U`mdY`cZ]bhY``YWi U``h\YZh'`+i`WUb`hU\_Y a UbmZcfa gž`Zīca `XY`]VYfUhY`W\YUh]b[ `hc`UVW]XYbhU``mVcdm]b[ `Zīca `U`gci fWY`k ]h\ci hUV\_bck `YX[ Ya Ybh' H\Y`I b]j Yfg]mi\Ug`UXcdhYX`Ub`YXi WUh]j Y`UddfcUV\'hc`d`U[ ]Uf]ga `UbX`\Ug`XYj Y`cdYX`U`fUb[ Y`cZ fYgci fWYg`hc`gi ddcfhigh XYbhg"`5```h\Y`XYhU]`g`cb`d`U[ ]Uf]ga ž`]bWi X]b[ `gca Y`i gYZ ``fYgci fWYgž`WUb`VY Zci bX`Uhi<u>k k k "qh XYbh'i bgk "YXi "Ui #d`U[ ]Uf]ga</u>."

5```A]b]b[`'9b[]bYYf]b['gh XYbhg`UfY`fYei]fYX`hc`Wcad`YhY`U`gh XYbhXYWUfUh]cb`Zcf`UWUXYa]W]bhY[f]hm k \]WX`]g`ci`h]bYX`]b`h\Y`Ugg][baYbhWcj`Yf`g\YYhg"`6mg][b]b[`h\]g`XYWUfUh]cbž`mci``U[fYY`h\Uhmci`f`kcf\_`]g mci`f`ckb`cf][]bU``kcf\_"

Zmci 'bYYX'gca Y'UXX]h]cbU`'gi ddcfhk ]h 'mci f'k f]h]b[ 'g\_]`gžd'YUgY WcbhUWhAY'@YUfb]b[ '7 YbhY'cf'j ]Yk gca Y'cZh\Y'fYgci fW'g'cb'h\Y]f'k YVg]hY. <u>k k k "Wi bgk "YXi "Ui "</u>''H\Y @YUfb]b[ '7 YbhY']g'XYg][ bYX'hc'\Y`d mci ']a dfcj Y'mci f'UWUXYa ]Wk f]h]b[ 'UbX'Wca a i b]WUh]cb'g\_]`d'Gca Y'gh XYbg'i gY'h\Y'7 YbhY'gYfj ]Wg VYWUi gY'h\YmUfY'Z]bX]b[ 'h\Y]f'Ugg][ ba Ybhg'U'W\U`Yb[ Yžeh\Yfg'VYWh gY'h\Ymk Ubhhc']a dfcj Y'Ub'U`fYUXm gi WWggZ `'UWUXYa ]WdYfZcfa UbW'"

# 5₩UXYa]W≢bZcfaUh]cb

# 7 ci fgY FYgi `hg

: cf`XYHJ]`g`cb`l BGK `UggYgga Ybhdc`]Whž'd`YUgY`j ]g]h`



- VfcUXVUbX WcbbYWfjcb f&) \* \_\_V]h#gYWcf ZJghYfŁ
- UV]`]hmhc`j ]Yk `ghfYUa ]b[ `j ]XYc`fN][ \`cf``ck `XYZ]b]h]cb`l BGK `HJ `cdh]cbgŁ

A cfY`]bZcfa Uh]cb'UVci hgmghYa 'fYei ]fYa Ybhg`]g'Uj U]`UV`Y Uh<u>k k k "ghi XYbh'i bgk "YXi "Ui #a ccX`Y!gmghYa !fYei ]fYa Ybhg</u>

#### 5\WWgg]b[`7cifgY`AUHYf]U`g`H\fci[\`AccX`Y

7 ci fgY ci h]bYgžgi ddcfha UhYf]U`gʻUfYʻi d`cUXYX`hc`A ccX`Yžh\Y`i b]j Yfg]mighUbXUfX`@YUfb]b[ A UbU[ Ya YbhGmghYa `f@A GŁ" =b`UXX]h]cbžcb!`]bY`Ugg][ ba Ybhigi Va ]gg]cbg`UfY`a UXY`i g]b[ `h\Y Ugg][ ba YbhXfcdVcl `ZUVJ`]hmdfcj ]XYX`]b`A ccX`Y" 5```Ybfc``YX`ghi XYbhg`UfY`Ui hca Uh]WU``mi]bWi XYX`]b A ccX`Y`Zcf`YUW\`Wci fgY"`Hc`UVWYgg`h\YgY`XcW a Ybhg`UbX`ch\Yf`Wci fgY`fYgci fVYgžd`YUgY`j ]g]h` <u>k k k "a ccX`Y'hY`h'i bgk "YXi "Ui</u>

#### < ck KY7 cbHJWhMci

5 hh]a Ygžh, Y'GW, cc``cf`mci f`Wci fgY'Wcbj Ybcfg`a UmbYYX'hc`WcbhUWhimci `UVci himci f`Wci fgY'cf`mci f Ybfc`a Ybh'`Mci f`Wci fgY'Wcbj Ybcfg`k]```i gY'h, Y'Ya U]``Z bWf]cb`k]h,]b`A ccX`Y'cf`kY'k]```WcbhUWhimci `cb mci f`4 ghi XYbh'i bgk "YXi "Ui `Ya U]``UXXfYgg"

K Y'i bXYfgHUbX'h\Uhimci 'a Um\Uj Y'Ub'YI ]gh]b[ 'Ya U]`UWWci bhUbX'k ci 'X'dfYZYf'Zcfimci f'I BGK 'Ya U]`g'hc VY'fYX]fYWYX'hcimci f'dfYZYffYX'UWWci bh"D`YUgY'gYY']bghfi Wn]cbg'cb'\ck 'hc'fYX]fYWhimci f'I BGK Ya U]`g.''<u>< ck 'WUb'=Zcfk UfX'a mYa U]`g'hc'Ubch\Yf'UWWci bh3″</u>

#### < ck Mci 7Ub 7cbHJWhIg

K Y UfY U'k Umg fYUXmhc Ugg]ghimci 'k ]h. mci f ]bei ]f]Yg" Hc Ybgi fY mci f ei Ygh]cb ]g X]fYWYX hc h. Y WcffYWh dYfgcbžd YUgY i gY h. Y Ya U] UXXfYgg VY ck 'Zcf.

 9bfc`a Ybhcf`ch\Yf`UXa ]b`ei Ygh]cbg`fY[UfX]b[ `mci f`dfc[fUa .` \htdg.##\_bgk ]bg][\hta ]\#cgcZt\#a dcftU`g"\\ca #\YV!Zcfa g#

٠

 $\label{eq:constraint} \begin{array}{l} K = Y^{UW}bck^{YX}[Y^{H}Y^{G}YXY][U^{T}dYcd^{Y}k^{T}bY^{H}UX]h]cbU^{T}WghcX]Ubg^{T}cZhY^{T}UbXg^{T}cb^{K}^{W}I=BGK\\ ? Ybg]b[hcb^{W}adig^{T}g^{T}cWhYX'' \end{array}$