Dear Class,

Joseph Moor and I have found what appears to be a bug in Maple 15 running on Macintosh Darwin 10.8.0 that causes incorrect answers. This may effect your solution to exercise 5.28 and possibly exercise 5.33 in Walnut if you use Maple for your calculations. I have verified that this particular bug neither appears in Maple 12 running on Windows on the UNR Citrix server nor in Maple 9.5 running under Linux.

Consider the functions $p_{j,k}$ defined by

$$p_{j,k}(x) = 2^{j/2}\chi_{\left[\frac{k}{2^j},\,\frac{k+1}{2^j}\right)}(x) \qquad \text{where } j = 0, 1, 2, \ldots \text{ and } k = 0, \ldots, 2^j - 1$$

which are all supported on the interval $[0, 1)$. Clearly

$$\int_0^1 p_{j,k}(x)\,dx = 2^{j/2}\Big(\frac{k+1}{2^j} - \frac{k}{2^j}\Big) = 2^{-j/2}.$$

Maple code to define $p_{j,k}$ and compute this integral is given by

```
1 restart;
2 V:=j::integer,k::integer,j>=1,k>=0,k<=2^j-1;
3 chi:=(a,b)->piecewise(x>=a and x<b,1);
4 p:=(j,k)->2^(j/2)*chi(k/2^j,(k+1)/2^j);
5 A1:=int(p(j,k),x=0..1) assuming V;
6 simplify(A1);
```

This code produces the following output:

Maple 15 on Macintosh

```
    |\^/|     Maple 15 (APPLE UNIVERSAL OSX)
._|\|   |/|_. Copyright (c) Maplesoft, a division of Waterloo Maple Inc. 2011
 \  MAPLE  /  All rights reserved. Maple is a trademark of
 <____ ____>  Waterloo Maple Inc.
      |       Type ? for help.
> restart;
> V:=j::integer,k::integer,j>=1,k>=0,k<=2^j-1;
                                                              j
           V := j::integer, k::integer, 1 <= j, 0 <= k, k <= 2  - 1

> chi:=(a,b)->piecewise(x>=a and x<b,1);
                chi := (a, b) -> piecewise(a <= x and x < b, 1)

> p:=(j,k)->2^(j/2)*chi(k/2^j,(k+1)/2^j);
                                    (1/2 j)      k    k + 1
                    p := (j, k) -> 2        chi(----, -----)
                                             j     j
                                            2     2

> A1:=int(p(j,k),x=0..1) assuming V;
                                    (- j/2)
                           A1 := 2        (k + 1)
```

```
> simplify(A1);
                                  (- j/2)
                                 2        (k + 1)

> quit
memory used=53.6MB, alloc=44.9MB, time=0.71
```

Maple 12 on Windows

```
    |\^/|     Maple 12 (X86 64 WINDOWS)
._|\|   |/|_. Copyright (c) Maplesoft, a division of Waterloo Maple Inc. 2008
 \  MAPLE  /  All rights reserved. Maple is a trademark of
 <____ ____>  Waterloo Maple Inc.
      |       Type ? for help.
> restart;
> V:=j::integer,k::integer,j>=1,k>=0,k<=2^j-1;
                                                                    j
            V := j::integer, k::integer, 1 <= j, 0 <= k, k <= 2  - 1

> chi:=(a,b)->piecewise(x>=a and x<b,1);
                chi := (a, b) -> piecewise(a <= x and x < b, 1)

> p:=(j,k)->2^(j/2)*chi(k/2^j,(k+1)/2^j);
                                    (1/2 j)      k    k + 1
                    p := (j, k) -> 2        chi(----, -----)
                                                  j     j
                                                 2     2

> A1:=int(p(j,k),x=0..1) assuming V;
memory used=7.6MB, alloc=5.8MB, time=0.22
                               (j/2) /   k     k + 1\
                         A1 := 2     |- ---- + -----|
                                     |    j      j  |
                                     \   2      2   /

> simplify(A1);
                                   (- j/2)
                                  2

> quit
memory used=12.3MB, alloc=6.7MB, time=0.42
```

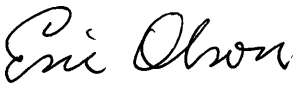
Maple 9.5 on Linux

```
    |\^/|     Maple 9.5 (IBM INTEL LINUX)
._|\|   |/|_. Copyright (c) Maplesoft, a division of Waterloo Maple Inc. 2004
 \  MAPLE  /  All rights reserved. Maple is a trademark of
 <____ ____>  Waterloo Maple Inc.
      |       Type ? for help.
> restart;
> V:=j::integer,k::integer,j>=1,k>=0,k<=2^j-1;
                                                                    j
            V := j::integer, k::integer, 1 <= j, 0 <= k, k <= 2  - 1

> chi:=(a,b)->piecewise(x>=a and x<b,1);
```

```
                chi := (a, b) -> piecewise(a <= x and x < b, 1)

> p:=(j,k)->2^(j/2)*chi(k/2^j,(k+1)/2^j);
                                    (1/2 j)      k    k + 1
                    p := (j, k) -> 2        chi(----, -----)
                                             j     j
                                            2     2

> A1:=int(p(j,k),x=0..1) assuming V;
bytes used=4000112, alloc=3472772, time=0.09
                                (j/2) /   k     k + 1\
                         A1 := 2      |- ---- + -----|
                                      |    j      j  |
                                      \   2      2   /

> simplify(A1);
                                     (- j/2)
                                    2

> quit
bytes used=5886936, alloc=3472772, time=0.14
```

As mentioned earlier, Maple 15 produces an incorrect answer for this computation while Maple 12 and Maple 9.5 produce correct answers. Be careful when using any computer algebra system for piecewise defined functions. I would be interested in the results if you run this code on other Maple versions.

All the best,



Eric Olson