> Math 211 : MAPLE Homework Solution #6 -- *Your NAME*

Problem 6: Using Maple's chrem(..) command to solve simultaneous congruences:

First system:

> $a := [2, 3, 5, 6]; m := [4, 5, 7, 9];$

$$a := [2, 3, 5, 6]$$
$$m := [4, 5, 7, 9] \tag{1}$$

> $x := chrem(a, m);$

$$x := 978 \tag{2}$$

Thus, the solution to the simultaneous congruences is x = 978 mod(4*5*7*9). This is correct because rem(x, 4) =2, rem(x, 5) =3, rem(x, 7) =5, rem(x, 9) = 6. We can check this by using the command

> $[seq(irem(x, m[i]), i = 1 ..4)];$

$$[2, 3, 5, 6] \tag{3}$$

The result is the set of values of a. A better way to check this is by using the evalb command:

> $evalb([seq(irem(x, m[i]), i = 1 ..4)] = a);$

$$true \tag{4}$$

Note: We could also use modp(..) in place of irem(..).

Second system:

Since this system is not in the form x = a_1 (mod m_1), ..., x = a_r (mod m_r), we first have convert the system to this form. There are two ways to do this:

First solution: Manually convert each congruence to the desired form:

For example, since 3*3 = 1 (mod 4), the equation 3x = 2 (mod 4) is equivalent to x = 6 (mod 4) . Similarly, 2x = 3 (mod 5) is the same as x = 9 (mod 5), and 4x = 5 (mod 7) becomes x = 10 (mod 7) and 5x = 6 (mod 9) means x = 12 (mod 9) . Thus, we apply chrem with a replaced by b, where b=[6, 9, 10, 12].

> $b := [6, 9, 10, 12];$

$$b := [6, 9, 10, 12] \tag{5}$$

> $y := chrem(b, m);$

$$y := 1074 \tag{6}$$

This is the correct solution because if we compute

> $[irem(3 \cdot y, 4), irem(2 \cdot y, 5), irem(4 \cdot y, 7), irem(5 \cdot y, 9)];$

$$[2, 3, 5, 6] \tag{7}$$

then we obtain the coefficent vector on the right hand side of the original second system.

Second solution: use chrem with fractions

For example, dividing both sides of 3x = 2 (mod 4) by 3 yields x = 2/3 (mod 4)., and similarly 2x = 3 (mod 5) is the same as x = 3/2 (mod 5), etc. Thus:

> $chrem\left(\left[\frac{2}{3}, \frac{3}{2}, \frac{5}{4}, \frac{6}{5}\right], m\right);$

$$1074 \tag{8}$$

gives the same answer as before.

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