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//CTNT Lecture #3 (Basics of// Magma)

//Online calculator: http://magma.maths.usyd.edu.au/calc/

//Commands need to end in ";" !!

/*
This is a multi lined comment
This is how you batch comment things out!
*/

GF(

RR:=RealField(100);
Pi(RR);

?RealField
?1

GF(25);
Integers(25);

PrimesUpTo(97);  //closed intervals
PrimesInInterval(11, 100);  //closed intervals
RandomPrime(100); //random prime less than 2^100




Divisors(12);
NumberOfDivisors(12);
MoebiusMu(12);
MoebiusMu(11);
MoebiusMu(10);

sum:=0;

for i:=1 to 10 do
        sum:=sum+NumberOfDivisors(i);
end for;
sum;



sumdiv := function(n)
    sum:=0;
    for i:=1 to n do
        sum:=sum+NumberOfDivisors(i);
    end for;
    return sum;
```

```
end function;

sumdiv(10);



LegendreSymbol(2,7);
LegendreSymbol(5,7);

KroneckerSymbol(7,2);


IsSquarefree(10);
IsSquarefree(12);


// p-ADIC INTEGERS

Z := pAdicRing(7,20);
Q := pAdicField(7,20);
P<x> := PolynomialRing(Q);

Z!(1/3);

HenselLift(x^3+x+5,Z!1);

Factorization(x^3+x+5);

Factorization(x^2-5);

L := ext<Q|x^2-5>;
L;


// NUMBER FIELDS

P<x> := PolynomialRing(Rationals());P;
f := x^2+5;
K<a> := NumberField(f);
fK<y> := ChangeRing(f,K);fK;
Roots(fK);

O := MaximalOrder(K);
Discriminant(O);
Basis(O);
O.1 eq 1;
MinimalPolynomial(O.2);

Factorization(3*O);
Factorization(5*O);
```

```
Factorization(ideal<O|6>);


//CLASS GROUPS

G, map := ClassGroup(K);G;
#G;
Generators(G);
G.1;
map(G.1);

I1 := ideal<O|[O.1+O.2,3]>;I1;
I2 := ideal<O|[O.1+O.2,2]>;I2;

Inverse(map)(I1);
Inverse(map)(I2);
Inverse(map)(ideal<O|6>);

F:=NumberField(x^2-2*3*5*7*11*13);
G:=ClassGroup(F);
IsAbelian(G);
ElementaryDivisors(G);
GroupName(G);

//CURVES

A<x,y> := AffineSpace(GF(37),2);
C:=Curve(A,x^3+y^3-2);
Genus(C);

P:=C![1,1];
E:=EllipticCurve(C,P);

A<X,Y,Z> := ProjectiveSpace(GF(37),2);
C:=Curve(A,X^3+Y^3-2*Z^3);
P:=C![1,1,1];
E:=EllipticCurve(C,P);
E;

Div:=DivisorGroup(C);
CL,a,phi:=ClassGroup(C);
CL;

CL.1 @@ phi;
CL.2 @@ phi;


CD:=CanonicalDivisor(C);
CD;
Decomposition(CD);
```

```
Places(C![1,1,1]);
D:=Div!(Places(C![1,1,1])[1]);
D;

RiemannRochSpace(D);
RiemannRochSpace(2*D);
RiemannRochSpace(3*D);

Basis(RiemannRochSpace(D));
V1,map1:=RiemannRochSpace(D);
B1:=Basis(V1);
B1;
map1(B1[1]);

V2,map2:=RiemannRochSpace(2*D);
B2:=Basis(V2);
B2;
map2(B2[1]);
map2(B2[2]);

RiemannRochSpace(6*D);
```